This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

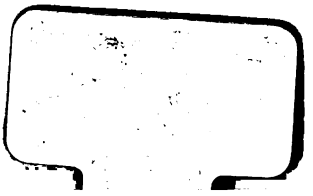
+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`



BOTANY FOR CHILDREN.

BY THE SAME AUTHOR.

FLORAL DISSECTIONS.

ILLUSTRATIVE OF TYPICAL GENERA OF THE BRITISH NATURAL ORDERS.

For the Use of Schools and Students in Botany.

Demy 4to, with Eight Plates, containing many hundred Illustrations, and Descriptive Letterpress, boards, 4*s*.

THE BOTANICAL LESSON.

THE LATE PROFESSOR HENSLOW WITH HIS VILLAGE SCHOOL CHILDREN.

(*From Life.*)

BOTANY FOR CHILDREN.

AN

ILLUSTRATED ELEMENTARY TEXT-BOOK

FOR

JUNIOR CLASSES AND YOUNG CHILDREN.

BY THE

REV. GEORGE HENSLOW, M.A., F.L.S., F.G.S., F.C.P.S.,

Lecturer on Botany at St. Bartholomew's Hospital Medical School,
the Birkbeck Institute, &c., and
Examiner in Natural Science for the College of Preceptors.

LONDON:
EDWARD STANFORD, 55, CHARING CROSS.

1880.

191. f. 198.

PREFACE.

(*For the Teacher.*)

THE great advantage of Botany as an educational means is that, of all subjects of Natural History, it alone can be easily taught to very young children. But up to the age of ten or twelve, and sometimes even beyond that, the *aid* and *sympathy* of a teacher are absolutely indispensable. Hence, while it is hoped that elder children may be willing to use this little book to a great extent by themselves, it is not intended that younger ones should do so without extraneous help. If, however, the teacher will aid the child in dissecting and examining the details of structure, and conjointly let the pupil read the description of them, a permanent interest will be secured which will then, it is hoped, induce the learner to proceed subsequently to a more advanced study of plants.

The dissection of flowers, the critical examination of their minute differences, the comparative study of kindred forms, together with the recording in a systematic way of all the points of structure observed in any plant, and finally to *draw** every peculiarity, will,

* Before drawing from nature, the pupil will acquire facility if he be taught to copy a selection of the figures on the lithographed plates, 'Floral Dissections,' published by Mr. Stanford.

together, be found a most invaluable aid to the other branches of a child's education. To do these things well is the only real way of making progress in the science; and they, in fact, constitute the most essential part of botanical study.

To describe plants, a knowledge of some technical terms is requisite. These will be found fully explained, as well as the right method of describing flowers, in the admirable little book by Professor Oliver, called 'Lessons in Elementary Botany' (Macmillan), which, indeed, this present volume is intended to precede: though any elaborate description of plants is not proposed for such young children as those for whom this book is intended.

The teacher should encourage the pupil to examine and describe as many plants as possible indiscriminately, as they come to maturity in the course of the summer; as well as *study* a selected series of them as *types* to represent as many families of plants. As the first object in learning Botany, to be put before the pupil, is that he should learn to be familiar with the principal *Families* or Orders of plants, it is with this view, viz. as types of families, that the plants have been selected for this book. They represent twenty-five families in all. Several other important ones have not, for want of space, been represented; such, for instance, as the Poppy Family, the Mallow Family, the Carrot Family. These and others, however, will be learnt subsequently, when the plants described by Professor Oliver come to be especially studied, as being the types which he has selected.

The descriptions of flowers in this book are intended

to form Botanical Reading Lessons, specimens of the flowers being at the same time placed in the hands of the pupils, who are required to dissect and examine them carefully, and *be sure they see* and *understand* each separate point noticed in the text.

The pupils must always write down under the several parts of the flowers, as dissected out, their descriptions, as given for the Lesser Celandine and Wallflower; but the Teacher is expected to explain in all other cases what they are required to write. It might be first written on the Black Board.

As the pupils thus study types of Families, they will at the same time be learning the characteristic features of the leading *genera* as well. Lastly, but which is of somewhat less importance at first, they will learn the characters of important *species*.

In this way a sound knowledge of plant structure will soon be obtained.

While the pupil is thus acquiring a knowledge of structural botany or *Morphology*, he should also be made to understand, in a general way, the *uses* of all the different parts to the plant itself, or *Physiological* botany. This is the plan followed in the following descriptions, special physiological features being described whenever special cases occurred which admitted of it. Such will be found to greatly enhance the interest of the study, to rescue it from a mere acquisition of details, and to elevate it to the position of a really intelligible pursuit.

Finally, the various uses of different parts of plants to man may be added, as furnishing much additional interest. Some few are appended to each plant de-

scribed. The Teacher will find the 'Treasury of Botany' (Longmans) of great use.

The descriptions of the several plants will be found not only of unequal lengths, but to contain very different degrees in the amount of matter compressed into them. It is left entirely to the discretion of the teacher to determine how much it may be desirable for a child to read and study at any one time. Hence I have not thought it desirable to divide the work into "Lessons."

A word as to the order in which the different typical plants herein described may be studied. They are arranged in accordance with our British Floras, but they do not blossom in the same consecutive order at all; hence a teacher must always incur a difficulty in not being able to procure just the plant wanted at any particular time. I have stated the *months* in which they flower. I would, therefore, recommend teachers to commence the study with the following plants:— Lesser Celandine, Wallflower, Violet, Primrose, White Lamium, Daffodil, Bluebell, Dandelion, Nut, Willow.

It need hardly be observed that the pupils should be repeatedly questioned to see if they remember the meaning of the *terms* used in the previous reading lesson, as they will rapidly forget them, unless they are again and again illustrated and explained.

The drawings, which are from nature, and the lithographed plates from them, are a joint production of my sister, Mrs. R. C. Barnard, and myself.

The frontispiece has been executed by Mr. W. G. Smith, from a sketch from life, by my uncle, the late G. Jenyns, Esq., of Bottisham Hall, Cambs. It is an

admirable likeness of my father, who, as is well known, introduced Botany into his Village School of Hitcham, Suffolk, and was the first who, by means of the "Floral Schedule," rendered the science capable of being taught to children not only with great simplicity, but also on a thoroughly scientific basis.

If country clergymen would but follow his example, they would be doing a great good, and with more pleasure than trouble to themselves. Perhaps the present work may be found useful in enabling them to commence; while an account of the late Professor's methods will be found in the 'Leisure Hour' for 1862 (p. 676).

I shall be most happy to give all the information or aid in my power to anyone who may feel disposed to communicate with me on the subject.

G. H.

6, Titchfield Terrace,
Regent's Park, N.W.

CONTENTS.

INDEX OF TERMS, ETC.

The Numbers indicate the Pages where each Term is alluded to.

LESSER CELANDINE.

BOTANY FOR CHILDREN.

THE PLANT AND ITS PARTS.*

THE VEGETATIVE ORGANS OF THE LESSER CELANDINE.—To study flowers, it is not enough to *read* about them. You must always examine the living plants themselves; so, as soon as you can, get each one of those which are described in this little book. Dissect and look at them carefully while you read it.

One of the first of our Spring flowers to appear in April and May is called the Lesser Celandine. It is an early flowering kind of Buttercup. Dig it up by the roots; and we will begin by studying those parts which keep the plant alive, and which enable it to grow, and which botanists call the *Vegetative organs* or parts. Any part of a plant which has something to do is called an *Organ.*

The *Root* consists of a bundle of thick, juicy clubs, called *tuberous* roots, mixed with some fine threads, called *fibrous* roots or rootlets.

The *Leaves* arise from a very short *Stem*, so that they seem to, but do not really, come from the root. They have two parts, the *Stalk* and the *Blade.* The former

* It is advisable for the pupil to be provided with a penknife and a pocket lens for dissecting and examining the smaller parts of plants.

widens at the *base*, and so protects a little *Bud* growing in its corner or *Axil*. The buds of this plant, especially if it has grown in the shade, sometimes take the form of little balls, drop off and grow into new plants, and are a kind of *Bulb*; but bulbs are buds which are generally produced underground, as by a Tulip or Snowdrop. The blade is the flat, green part of the leaf, and as the stalk carries but one blade, it is called a *Simple Leaf*.

THE USES OF THE VEGETATIVE ORGANS.—The fine thread-like rootlets serve to draw up moisture and several things dissolved in it from the soil, with which the plant is partly nourished; but the club-like roots are little store-rooms full of its prepared food, laid by last year. If you examine them, *after* the plant has flowered, you will find them partly shrivelled up, while other clubs will have begun to form around and above them in the summer for next year's use. Or else they may become detached and grow into several distinct plants, because each of these clubs carries a bud at the top.

The Leaf is one of the most important parts of a plant, for by means of it the plant digests its food, which has been partly drawn up by the roots, dissolved in water; but it also takes in and lives upon the *impure* air (called *carbonic acid gas*) which we breathe out of our lungs; and as long as there is sunlight, leaves and other green parts of plants continue to purify bad air by breathing out, in exchange, the pure air (*oxygen*) which we breathe in. But this only goes on during the day. At night plants breathe as we do; so that it is very useful to have plenty of trees and shrubs in a town;

but it is bad to sleep in a room with many green plants in it, or with many strong-scented flowers.

THE REPRODUCTIVE ORGANS OF THE LESSER CELANDINE.—Let us now turn to the upper part of the plant which bears Flowers. As the use of flowers and fruit is for the purpose of *setting seed* to *reproduce* the plant, these parts are called *Reproductive organs.*

Gather a Flower. Look at it upside down. You will see three little greenish-yellow parts. Pull them off, place them on a sheet of paper by themselves and write under them—"The three *Sepals* of the *Calyx.*" Next, you will count about eight bright yellow parts. Remove them, and write under them—"The eight *Petals* of the *Corolla.*" As the sepals are all alike, and the petals all alike, we say of the Calyx and of the Corolla that they are both *regular.* Observe a tiny hollow place with what looks like a little petal in front of it, near the bottom of each petal. It often has a drop of fluid in it. It is shown in Fig. 1.* This is called a *Gland.* Glands are for the purpose of *secreting* honey for bees to collect.

Now remove the small yellow stick-like things. Each of these is called a *Stamen* (see Fig. 2). The yellow top is made of two longish bags standing back to back, and which burst by long slits. They are called the two *Cells* of the *Anther,* while the stalk which carries it is the *Filament.* The continuation of the filament between the anther cells, which *connects* them together, is called the *Connective.* When the bags burst, a yellow powder falls out; this is called *Pollen.* Place all the

* The figures of parts of the flowers are nearly always enlarged.

stamens together, and write under them—"The *Stamens*, each of which is made of a *Filament* which bears the *Anther*; the two *Cells* of which are joined by the *Connective*, and shed *Pollen*."

There yet remains one more part of the flower, called the *Pistil*. This is made up of a great many little green bag-like bodies, with rough tips to them. You will require to magnify them a little. Each is called a *Carpel* (Fig. 3), and within the lower, enlarged part of each, called the *Ovary*, is a little body, or *Ovule*, which in time would become a *Seed*, when the carpels shall have ripened into the *Fruit*; though it often fails to ripen in this plant. You may generally see the ovule *through* the carpel by holding it up to the light. Place the carpels of the pistil together on the paper and write below them—"The *Pistil* made up of many separate *Carpels*."

Lastly, the swollen end of the Flower-stalk, which carries or *receives* the parts of a Flower, is called the *Floral Receptacle*. Place it by itself, and write below it—"The *Floral Receptacle*."

If you can draw, try to copy a sepal, a petal, a stamen, and a carpel, as shown you in the enlarged Figs. 1, 2, and 3. Indeed, you should learn to draw everything you examine.

These four parts, or *Calyx*, *Corolla*, *Stamens*, and *Pistil* are called the four *Floral Whorls*.

THE USES OF THE REPRODUCTIVE ORGANS.—Let us now see what are the uses of all these parts. The Calyx *was* of use before the flower opened, as its three sepals wrapped up the young stamens and carpels, and so protected them. The Corolla is *now* of use, for it

makes the flower very bright, and easily seen by bees, which come to suck the honey from the glands of the petals. The Stamens shed the dust-like pollen from the anthers; and the powdery pollen is a most important substance, for without it there can be no seed; for it is found that some of this pollen *must* fall on to the tip of each carpel, which you can see looks rough, and which is called the *Stigma;* it is also sticky, so as to catch and retain the pollen dropped upon it. While there, it has a curious effect upon the ovule inside the ovary below—that is, the young seed; and unless the pollen do fall on the stigmas, the carpels will shrivel up, and the ovules will perish with them. But if it fall on the stigmas, though all the rest of the flower will fall off, the little carpels will remain, as they have now been *fertilized,* and grow bigger and bigger, so that when a Buttercup has "gone to seed," you can take the little round heads, and by slightly rubbing them, all the now ripened carpels will be detached, and each one will be found to contain a seed within it. Each of such seed-like *fruits* is called an *Achene* (pronounced *akeen*).

two kinds of leaves; those which float being roundish and green, while all that are quite under water are finely divided into thread-like segments. It sometimes has all its leaves submerged, and then there are no broad green leaves at all.

Now these five kinds of Crowfoot or Buttercup may always be known by the particulars I have described, and botanists say they are so many *Species* of one *Genus*. The Latin name **Ranunculus**, and the English Buttercup, or Crowfoot, is that of the *genus*, while the "Lesser Celandine," the "Bulbous," the tall "Field," the "Creeping," with its runners, and the "Water Crowfoot," are separate *species* of Buttercup. There are about sixteen species of Buttercup in all in Great Britain.

There are many plants which agree with the Buttercups in having *a large number of stamens* (which, with the sepals and petals, *all fall off* in the fruiting state), and mostly with *several carpels which turn to achenes;* such as the Traveller's Joy, the Wood Anemone, the Pheasant's Eye, and the Mousetail. In some others, the carpels are not so numerous, and turn to little *Pods* with many seeds (instead of having one only, as the achene). These pods burst down one side only, and are called *Follicles*. The following plants agree with the Buttercups in many respects, but differ in the fruit; the Marsh Marigold, the Larkspur, the Columbine, the Aconite, and the Pæony. They differ, it is true, in the calyces and corollas (by which each of these *genera* * is known), yet they nevertheless agree in the above-mentioned and many other particulars; thus nearly all have the

* *Genera* is the plural of *genus*.

leaf-stalk *sheathing* at the lower part, and their leaves with their blades divided into segments, the Lesser Celandine and Marsh Marigold being exceptions to this rule. Again, all, excepting the Water Crowfoot, are more or less *poisonous*, especially the deadly Monkshood or Aconite. All these plants, then, having so much in common, botanists group together, and say they make a *Family*, of which each of the above-named is a *Genus;* each genus including one or more *Species.*

If you have been able to get all or some of the plants here mentioned, and have examined and compared them together, you will then understand how we can now write down a *General Description of the Buttercup Family.* That is to say, we can group together all the *characters* which the different genera have *in common*, not noticing for the time any exceptions which may be found in particular genera of the family. Thus we may write down the following facts as:—

THE GENERAL DESCRIPTION OF THE BUTTERCUP FAMILY.

Herbs with a poisonous juice.

Leaves with divided blades and sheathing stalks.

Flowers, sepals and petals very various, but peculiar to each genus; stamens, many; carpels, many or few.

Fruit either of many one-seeded *achenes* or of a few many-seeded *follicles.*

Of the Buttercup Family, several are cultivated as garden plants, such as Bachelor's Buttons, a *double* form of the Field Buttercup; that is to say, in the place of stamens and carpels, there is a dense mass of yellow petals. Of course, such a flower can set no seed. Then there are Columbines, Larkspurs, Monks-

hoods, and Pæonies. All of these are poisonous, but especially the Monkshood. Hence you should never put leaves or petals in your mouth, as you cannot tell, till you have learnt more about plants, whether you may not be accidentally poisoning yourself or not, as, indeed, many persons have done. Tramps, however, have been known to rub the juice of the Traveller's Joy (also called *Clematis*) and of Buttercups into their arms to create sores, in order to excite compassion, and so impose upon kind-hearted people. Though so very poisonous, the Aconite, or Monkshood, or Wolf's-bane, for it is called by all three names, is a very valuable medicine when used carefully and in very small quantities.

THE CRUCIFER FAMILY.

THE COMMON WALLFLOWER.

The name Wallflower is given to this plant, which blossoms in May, as it is often found growing on old ruins; and as the petals have the form of a *cross*, the family to which it belongs is called *Crucifers* or "Cross-bearers"; but you must not suppose that *all* flowers with four petals must therefore belong to this family.

Observe how the expanded flowers surround a dense cluster of closed buds in the middle; and as fast as the latter burst into bloom, the stem which carries them continues to grow; hence very soon the old flowers are left behind, and below, while the younger ones are rapidly carried up, so that when they are all in fruit, you see a very long *main stalk* called the *Peduncle*, with the pod-like fruits all the way up it, each fruit being carried at the end of its own *little stalk*, called the

Plate 2.

WALLFLOWER.

Stanford's Geogl Estabt

Pedicel. Botanists make use of the word *Inflorescence* for the whole stalk covered with flowers and taken all together. As flowers are often clustered in various ways on a common stalk in different plants, they have proposed different names for the several kinds of inflorescences. That of the Wallflower is the same as of a bunch of Currants, or of the Lily of the Valley, and is called a *Raceme.*

The Pedicels do not spring out of the axils of bracts, as in the Buttercup (p. 6), and as is usually the case with flowers; bracts in the Crucifer Family being, as a rule, entirely wanting.

Now let us dissect a flower carefully, and you will find there are four sepals, the front and back ones (that is, as you look at a flower while still upon the peduncle) overlap the two side ones. Whenever the parts of any whorl overlap one another by their edges, they are said to be *imbricate.* The side or *lateral* sepals have little pouches at the bottom to contain a drop of honey. Remove the sepals. The four petals will now be clearly seen to be fixed by long, slender stalks, called *Claws,* the broad part being called the *Limb* of the petal. Next observe that there are six stamens, of which the two outer stand at a lower level than the four inner ones, and are rather shorter than these latter, and observe, too, that the two former rise from dark-green cushion-like glands,* which secrete honey,

* Glands are not always of the same nature; but they all secrete honey. In the Buttercup, as described, they form little pits in the petals. In the Geranium they take the form of round knobs on the receptacle; and in the Wallflower as cushion-like structures at the base of the stamens. When the glands are continuous and form a complete ring, dish, or cup-like mass, it is called a *Disk.*

which is then caught and kept ready for insects in the tiny pouches of the lateral sepals just below them.

If you have now removed everything thus far, there will be nothing but the pistil remaining in the middle. The stout lower part is the ovary, which bears a very short *Style*, as the support to the two *Stigmas* is called. These two stigmas show that the pistil is really made of *two* carpels joined together, or as botanists say, are *coherent*. In order to understand how this *cohesion* has come about, I think the best way is to take two pea-pods: split them open, but down one edge only—namely, that which carries the peas: half the peas will be found clinging to one edge, and half to the other edge. Treat a second pod in the same way; and now place them face to face, and if the two pairs of edges which now meet grew together, we should have a pistil such as that of the Wallflower; only there is in the latter an *extra growth*, proceeding from the joined edges. These growths or projections from the opposite sides meet in the middle (while it is still a very small bud); there they join together and so make a sort of *dividing plate* across the middle of the ovary from top to bottom, the four rows of ovules being left behind where the edges first met. As this peculiar structure is much better seen when the pistil has ripened into a fruit, I will suppose you to have found the dry, ripe, pod-like fruit, which is called a *Siliqua*,* and you will see how two strips from the backs of the two carpels peel off from below upwards. These are called *Valves*. There then remains a sort of long and narrow framework, formed

* A Latin word, used by the poet Virgil in speaking of a Bean-pod.

of the *Placentas*, which carries a thin shiny plate, like a dull glass pane in a narrow window-frame. This plate, called the *False Dissepiment*, is the "extra growth" spoken of above.

The seeds spring from the frame-like placentas in *four* rows, though apparently forming only *one* row on *each* side of the dissepiment. If, however, you examine it very carefully, you will see that the seeds of each row spring alternately from opposite edges of the frame; so that, strictly speaking, there *are* four rows of seeds.

It will not be amiss to compare the flower and fruit of the Wallflower with those of the very common weed called Shepherd's Purse. The flower of this plant is of course much smaller than it, but its parts are mainly the same as that of the Wallflower in all the above particulars, except in their *form*. There is, however, rarely, if ever, any honey, and the stigma is of a round button-like shape. When flowers of the Crucifer Family have large corollas, are brightly coloured, and often scented and secrete honey, they have two stigmas, and insects coming to visit them pass their *Proboscis* over the notch between them, down to the little bags of honey. But when, like the flower of the Shepherd's Purse, they are very inconspicuous, they have nothing to attract insects, which, therefore, rarely visit them. In these the pollen falls on to the stigma directly from the stamens. Such flowers are said to be *self-fertilized*, while the larger flowers are said to be *adapted to be intercrossed* by insects, for they, of course, carry the pollen from flower to flower, and so *cross* the pistils with pollen brought from a different plant.

We must now compare the fruits. The long pod-like

fruit of the Wallflower is called a *Siliqua*, but the little wedge-shaped pod of the Shepherd's Purse is called a *Silicula*, which means a *little* siliqua. The valves are like little flat pouches, and separate from a very *narrow* dissepiment, on which the *four* rows of seeds are very easily seen. Lastly, compare the fruit of the Shepherd's Purse with that of the "Whitlow Grass," which grows abundantly on the tops of walls and on banks, and blossoms in April and May. The fruit of this latter is also a silicula, only the dissepiment is *broad* and the valves oval and not pouches.

GENERAL DESCRIPTION OF THE CRUCIFER FAMILY.

Herbs, none poisonous.

Inflorescence, racemes of flowers without bracts.

Flowers, sepals, 4; petals, 4, clawed; stamens, 6, of which two are short and four are long; pistil of two coherent carpels.

Fruit, a siliqua or silicula, with a dissepiment, bursting by two valves, and with four rows of seeds.

No plants of the Crucifer Family are poisonous, and many are very useful for food. The Wild Cabbage is a plant of the genus *Brassica*, with a number of rather large, thick leaves, growing on the chalk cliffs by the sea, in the south-east of England, near Deal, and elsewhere. It is the origin of all our many garden varieties. When we eat the *leaves* they are called "greens," or simply "cabbage." When, however, we cook the *flower-tops* in bud, we call them "Broccoli" and "Cauliflower." The Turnip is another species, while the seeds of a third yield Colza oil, useful for lamps. Other useful plants which we eat are the *foliage* of Water-cress, the young *seedlings* of

Mustard and Cress, the scraped underground stem or *Rhizome* of the Horse-radish, the blanched *leaf-stalks* of Sea-kale, &c. Of garden flowers we have the Stock, which is found wild on some of our sea-shores; the Virginia Stock; Honesty, with its large, broad siliculas, as big as halfpennies; Candy-tuft, and several others. They all agree with the flowers of the Wallflower, and you should make a point of dissecting and comparing together as many different kinds as you can find of this, as, indeed, of all other families.

Now, I want you to do with the parts of the flower of the Wallflower just what you did with those of the Celandine; and you must always do the same for *every* flower that you examine.

Placing the two outer, that is, the front and the back sepal together, write under them:—

"The front and back sepals, which overlap the side ones; so that the sepals are *imbricate*."

Next place the two side or *lateral* sepals by themselves, and write under them:—

"The *lateral* sepals with honey pouches."

Then put the petals together, and write as follows:—

"The four *clawed* petals."

Now we come to the stamens, and first the two outer and shorter, of which you must write:—

"The two outer and shorter stamens which rise from honey-glands."

Then for the four other stamens, add the words:—

"The four inner and taller stamens."

Lastly, for the pistil, write:—

"The pistil, made up of *two coherent* carpels."

If you have examined a ripe fruit, remove the two

valves, place them by themselves, and the placenta and seeds by themselves, and write:—

"The Fruit or *Siliqua*, bursting with two *Valves*, leaving a frame-like *Placenta* and false *Dissepiment* with four rows of *Seeds*."

I will not repeat this exercise for other flowers; but your Teacher will show you how you must write it out for every other flower and fruit you examine.

THE VIOLET FAMILY.

THE SWEET VIOLET.

There is but one genus of this family in this country, which furnishes us with all kinds of Violets and Pansies, or Heartsease.

Before we examine the flowers of the Violet, which blossoms in March and April, let us note a few things about the plant itself. There is a rugged-looking creeping stem, or rhizome, from which issue Runners, which bear young plants, as in the creeping Buttercup and in the Strawberry. From this stem the leaves arise, and it seems to be covered more or less with pointed *Scales*. The way in which the leaves have their edges rolled up, before they are fully expanded, is peculiar. Indeed, the various ways in which leaves of different plants are folded up in the bud form a very interesting study, and you should always look to see how it is done when examining any plant. Thus, in the Oak and the Lime tree, the two halves of the leaf-blade are folded *flat* together; while in the Vine, Beech, and Currant the two halves are similarly pressed

VIOLET.

Stanford's Geog.l Estab.t

together, but *crumpled*, like a fan. The leaf of the Cherry tree is rolled round and round like a roll of paper; and in Ferns, each little piece, as well as the one at the end of the blade, is rolled in upon itself, like a Bishop's crozier, or like a watch-spring. Several other kinds might be mentioned. It is an excellent practice to take any bud, cut it sharply across, and then try and draw the appearance of the cut edges. Thus, the leaf-bud of an apple-tree cut across would be represented by the following figure:

The next thing to note, is that the leaves have all got what are called *Stipules*. They are the pointed scale-like little leaves more or less covering the rhizome. There are two to each leaf, the leaf-stalk rising out from between them. The stipules are much larger in the Pansy, when growing on the flowering stem of the plant, and almost give the appearance of *three* leaves together, but only one, the largest of the three, is the true leaf. These appendages to a leaf, or stipules, do not occur on all plants, but are peculiar to certain families, and often take very different forms, and have very different duties to do. Thus in the Garden and Sweet Pea they are very large, and answer all the purposes of leaves; but in the wild pea they are much smaller, as you may see in Plate 8.

In the common, or False Acacia (as a tree is popularly called which has *white* flowers, resembling those of the Laburnum in shape), there are sharp-pointed spines, which take the place of stipules. In the Oak

and Lime trees, all the stipules have to do is to form *bud scales* to protect the little delicate folded leaves from the frost. I shall have further occasion to allude to stipules.

You should always make a point of searching in the fields, when you go out for a walk, for all these things that you read about, and never rest satisfied with *merely* reading about them.

We will now proceed to examine the flower. The stalk carries two little bracts, but they are doubtless a pair of stipules without any leaf belonging to them, the leaf itself not having grown at all.

The flower of the Violet is very curious in several respects. In the first place, it is upside down, as the stalk is twisted. The five sepals are attached to the stalk a little above their base, so that each carries a sort of little green tail behind (see Fig. 1). The corolla is clearly very *irregular*, that is, the petals are of different shapes, one petal having a long pouch, called a *Spur* (Fig. 2). There are five stamens, of which the two placed immediately over the spurred petal carry each a little tail which lies within the spur (Fig. 3). These tail-like glands secrete honey, which the spur catches. Cut the spur open from the end, upwards, with a pair of finely-pointed scissors, and you will see the anther-tails lying hidden within. The three other stamens have no tails (as in Fig. 4), and all five cluster round the ovary, covering it above with their orange, three-cornered, flap-like appendages. We now come to the pistil. Observe how the style is bent just above the ovary, and forms, as it were, a kind of spring there. It ends above with what looks like the beak of a bird. It has a small hole at the end (Fig. 5).

Any *irregular* flower, that is, one of which the petals or other parts are not all of the same shape, such as the Violet, you may be quite sure is adapted by its form to receive the visits of insects. In the case of the violet, the insect would pass its proboscis down the spur, and in so doing it passes between the lower stamens and gets dusted with pollen. On going into another flower, some of the pollen would be sure to be caught on the tip of the little "beak," and pass into the little hole, wherein lies the stigma. Nevertheless, from some unknown cause, the flowers of the violet rarely set any seed. Look down amongst the bases of the leaf-stalks, and you may see some very small buds, as marked by * * in the Plate. If you wait till all the larger blossoms have gone, and the plant has apparently done blossoming, when the leaves increase in size and number, then you will find a great quantity of these minute buds, as well as round *Capsules*, some half-ripe, others bursting with three valves (as in Fig. 6) and scattering their seeds.

Let us examine one of these little buds with a pocket lens (Fig. *a*). There is a small calyx composed of five sepals, as in the larger flowers. You will probably find no corolla, or at least very minute purplish green petals. There are two or more stamens (Fig. *c*), consisting of an oval part above which carries two little round anther-cells at its lower part. The anthers will be found pressed down together on the top of the ovary (as in Fig. *b*). The style has no "beak" but merely curls round under the anthers (Fig. *d*), so that the pollen is directly in contact with the blunt stigma at the end of the curling style, while it still is included within the anther-cells.

These little flowers which thus produce seed without the aid of insects are said to be *self-fertilizing*, and as the *union* between the pollen and the stigma is concealed within the *closed* buds, the word *cleisto-gamous* has been invented from two Greek words, meaning "enclosed" and "union."

Several other flowers have cleistogamous buds as well as conspicuous flowers, such as the Wood-sorrel (Plate 7), Balsams, and a kind of Lamium.

The structure of the Heartsease is very like that of the Violet, only the pistil has a globular "head" instead of a beak-like extremity, and, just as the violet, requires insects to fertilize it; but it never bears cleistogamous buds. Instead of these, there is a small flowering kind, found in corn-fields, with tiny, pale-yellow blossoms. These are capable of fertilizing themselves, as the pollen is able to fall directly into the hole in the head, which leads to the stigma within.

The fruit of Violets and Pansies is a little dry *capsule*, which bursts into three *valves*, each of which carries a cluster of seeds down the middle (Fig. 6). This shows that the pistil is made of three coherent carpels.

GENERAL DESCRIPTION OF THE VIOLET FAMILY.

Herbs.

Leaves with stipules.

Flowers irregular, with a spurred corolla; stamens, of which two have honey-secreting tails; pistil, with a one-celled ovary with three rows of ovules.

Fruit, a capsule bursting into three valves, each valve carrying many seeds.

Besides the sweet violet, which is sometimes *double*—

RAGGED ROBIN.

Stanford's Geog.l Estab.t

that is to say, there is a great number of petals standing in the place of the stamens and pistil, neither of which are formed at all—there is the large garden Pansy, which is a cultivated form of the wild one. Several foreign kinds are also grown.

The Violet Family does not contain any plants of much use to man. A few are used as medicine.

THE PINK FAMILY.

THE RAGGED ROBIN.

The genera of the Pink Family are divided into two groups, or *Tribes*, according as the sepals are *coherent* as in the Pink, or *free* as in the Stitchwort and Chickweed. We will take the Ragged Robin, which blossoms in May and June, as a type of the first, and the Stitchwort, which flowers rather earlier, in April, but often continues till June, as a type of the second *Tribe*.

First observe how the leaves are always arranged in pairs, and are said to be *opposite*. Each pair points in contrary directions to that of the next pair above or below it.

When leaves of plants spring singly from the stem they are said to be *alternate*, as is the case with the Wallflower and Violet, and, indeed, such an arrangement is much commoner than opposite leaves, though these latter are far from being rare. The leaves of all the plants of this family never have any saw-like or other indentations along the margin or edge, hence they are said to be *entire*.

See, also, how the stem is somewhat swollen at the

joints, or *Nodes*. Both of these features are characteristic of the family.

Let us first examine the *Inflorescence*, or the way in which the flowers are grouped together. Notice how the main stem, if you follow it from below upwards, *ends above in a flower;* then, the next to blossom are two in number, arising, one from each axil of the pair of bracts just below the first. These two blossom together, and so on: in every case, *the Peduncle* which arises from any axil *ends in a flower*, and cannot grow any more.

Now you will remember in the Wallflower *the Peduncle did not end in a flower*, but kept growing and growing, bearing a long succession of flowers all the way up into its side, but *no flower was ever formed at the end of the Peduncle.*

Hence we see, then, that Inflorescences may be of one of two kinds—*Indefinite*, as in the Crucifer Family, or *Definite*, as in the Pink Family. Because an indefinite peduncle means one which is not ended in a flower, whereas a definite one signifies that the flower at the end of the peduncle stops its further growth.

We will now proceed to dissect and examine the flower.

The Sepals are five in number, as is shown by the five little points on the top of the little tube or cup which is thus made up of *five coherent sepals* (Fig. 1). The Corolla has five petals, which are fixed, or, as botanists say, *inserted* by fine or tapering stalks, which, you will remember, we called *claws* in the Wallflower. Each petal carries two little forked appendages just at the top of the claw, and below the slashed petal-limb, as

shown in Fig. 2. Of the ten stamens, five are *adherent* to the petals. See Fig. 2. The other five are *free.*

You see I have used two words to signify a "joining" or "union":—*Cohesion* means "joining together," and is only used when the parts of any *one whorl* are united together, as the sepals of the calyx of the Ragged Robin. *Adherent* means "joined to," and is applied to any two or more, but *different whorls* which are fastened together; thus one of the whorls of five stamens is in this flower fastened to, that is, *adherent* to the Corolla whorl.

The Pistil is slightly raised by the growth of the flower stalk or receptacle. The carpels are five in number, as is easily seen by the five *free* styles, though their five ovaries are *coherent* together below, as shown in Fig. 3. The ovary, however, has only one cell. Cut it *straight down*, and you will see a column standing free in the middle. Cut the ovary of another flower *across*, and you will cut through the column, which you will observe carries a quantity of ovules all over its surface (as shown in Fig. 4).

The fruit is a capsule which opens by five *teeth*, which curl back at the top; through the opening thus formed, the seeds drop out (Fig. 5).

Of our British wild Flowers belonging to this family, there are five genera of the same group with the Ragged Robin. There are several species of Pink, such as the Deptford, the Maiden, and the Cheddar Pink: several others are cultivated under the names of Carnation and Piccotee. Then there are the Soapwort, Catchflys, Campions, and lastly, the Corn Cockle.

THE PINK FAMILY—*Continued.*

THE GREATER STITCHWORT.

The genera of the Pink Family which have their sepals free are often weed-like, and without conspicuous flowers, such as Chickweed, Pearlwort, Spurry, and Sandwort: but the Greater Stitchwort is one of the prettiest and commonest of wild flowers, brightening up our hedge-rows every April and May with its white star-like blossoms.

Notice the *definite* kind of inflorescence which was described under the Ragged Robin, and which is just the same in this plant; how every peduncle *ends* in a flower, the first to blossom being the single, central one, which ends the main stem; then *two* together; then *four* together, two on each of the last peduncles. And if it has strength to produce more flowers there would be *eight;* but after a time one or more flowers fail to grow. The whole group which makes up the inflorescence is called a *Cyme.*

There are five sepals which you can remove separately. Be careful not to mistake the number of petals, for it *looks* as if there were ten, but there are really only five, each petal being deeply notched. Moreover, the petals are not inserted by claws. Of the ten stamens, the five taller ones in front of the sepals shed their pollen first, then those in front of the petals; and about the same time as these last are so doing, the three styles grow and spread themselves out, so that they must generally have pollen brought to them by insects from other flowers. This state of things is very common in flowers with conspicuous corollas, and with two

GREATER STITCHWORT.

Stanford's Geogl Estabt

whorls of stamens, as we shall find with the Meadow Geranium. And even when there is only one whorl of stamens, it is a very common thing for the anthers to have shed most of, or all their pollen before the stigmas are sufficiently mature to receive it. Whenever this takes place, the flower is said to be *proterandrous*, a word made out of two Greek words, *proter—before*, and *androus*—which refers to *stamens*, meaning that the anthers are mature before the stigmas.

The pistil is composed of three carpels, as shown by the three styles, but the ovary is *one-celled*, as in the Ragged Robin. Cut it across and you will find the ovules arranged on a large column or *placenta*, which is thus said to be *free-central*, and is similar to that of the Ragged Robin. The fruit is a capsule which bursts into five valves, as shown in Fig. 3, with the five sepals remaining as well.

There are several species of Stitchwort, of which the Chickweed is really one, though called by another name. This has very inconspicuous flowers; it has only three stamens, and is almost always self-fertilized, especially in cold seasons, when the buds frequently remain closed, like the cleistogamous buds of the Violet. The stamens, however, have little glands at the bottom of the filaments, as in the Greater Stitchwort (see Fig. 1); so they can probably secrete honey in warm weather, as these tiny flowers *are* sometimes visited by bees.

GENERAL DESCRIPTION OF THE PINK FAMILY.

Herbs with stems having swollen nodes.

Leaves opposite and entire.

Flowers regular; sepals coherent or free; petals

clawed or not; stamens often twice the number of petals; pistil with coherent ovaries and free styles.

Fruit, a capsule with a free-central placenta bearing many seeds.

THE GERANIUM FAMILY.

THE MEADOW GERANIUM.

We have in Great Britain eleven species of Geranium, of which this one, blossoming from May to July, has the largest flowers. The corollas of the other species decrease in size till the smallest is not more than a quarter of an inch across.

Observe how the stems are somewhat swollen at the joints, or *nodes*, where the leaves arise, and that there are a pair of little *scale-like stipules* at this place. You see them very well in the garden scarlet Geranium. They act as protectors to the flower-buds, which arise from the axils of the leaves.

The flowers have all their parts in fives, there being two whorls of stamens, or ten in all.* The pistil has five carpels, with five separate curling stigmas. As in the Stitchwort, the five stamens which stand in front of the sepals, shed their pollen before the other five, and it is not till *all* the anthers have burst, that the stigmas are ready to receive the pollen; which must then be brought by insects from some other flowers.

If, however, you can get blossoms from a species called *G. pyrenaicum*, but which has no English name, you will find the pistil is ready for the pollen *after* the first set

* Figs. 1 and 2 show the back and front view of a stamen, with the filament inserted into the back of the anther.

MEADOW GERANIUM.

Stanford's Geog.l Estab.t

of stamens have shed their pollen, and *before* the second set have done so; so this species can be both crossed and also be self-fertilized. And if we take the smallest flowering species, *G. pusillum*, we shall find that the pistil has its stigma unfolded *before* any of the anthers have burst. Hence the genus Geranium is very instructive; for it shows us that when flowers are large and very conspicuous they require the aid of insects to fertilize them; but when they are comparatively much smaller and generally inconspicuous and insignificant looking, then they can mostly fertilize themselves.

I have already more than once drawn your attention to these facts, about intercrossing and self-fertilization, and you may begin to wonder what it all means, and why there are such differences. Well, botanists do not yet quite know enough about plant-life to say positively why some plants absolutely require the pollen to be brought to them from other flowers than their own, or they would die out for want of seed, if they could not propagate in any other way; why, again, some flowers are partly dependent on visitors and partly self-fertilizing; and, lastly, why some are quite independent of insects, and can fertilize themselves freely.

A fact easily to be seen is this: that those flowers which are visited are always attractive for their scent or bright colour, or are large and white. Indeed, they are mostly large flowers, and, if small, they are then massed together so as to become conspicuous *collectively*, as we shall see is the case with the Woodruff and the Daisy. On the other hand, flowers which are self-fertilizing are not usually at all conspicuous, and consequently insects do not, or very rarely, visit them.

They, however, set seed abundantly; as every gardener knows how troublesome many weeds are. It seems, therefore, that by intercrossing the plant receives some help, or *stimulus*, to its growth, so that its offspring become larger plants with more conspicuous flowers; but for merely *setting seed*, self-fertilizing plants are the best off, since they are not dependent upon the visits of insects; which, indeed, often fail to go to them in cold and wet weather.

When the pistil ripens into a fruit, the carpels detach themselves from below upwards, from a beak-like prolongation of the floral receptacle; each little egg-shaped ovary then bursts and drops its seed out. Fig. 3 shows the five carpels thus breaking away from the central support, the five sepals having remained on below.

THE GERANIUM FAMILY—*Continued.*

THE WOOD-SORREL.

This pretty little plant is fond of woods and shady banks. Its leaves are not unlike clover, and, like that plant, "go to sleep" by folding the three leaflets together. Many plants do this, and some will press their leaflets together if you do but touch them. A bough of the common False Acacia will sometimes fall asleep if shaken. But a plant called the sensitive plant, which covers the ground in some tropical countries, will close its leaves even when a horse gallops by!

The flowers of the Wood-sorrel, to be found in May, resemble the Geranium in having all the whorls of the same number, five. The five petals may be seen

WOOD SORREL.

Stanford's Geog.l Estab.t

in the illustration; and Fig. 1 shows the ten stamens in two sets of five each; five having long filaments, and five are with short ones, all surrounding the pistil with its five long styles.

This plant is remarkable for having, besides the white blossoms which open, other little *cleistogamous* buds which do not expand at all, just as in the Violet (see Figs. *a*, *b*, *c*, *d*).* In these the stamens are very short (Fig. *c*) and not at all elongated, as in the larger flowers (Fig. 1), so that while Fig. 1 shows that the conspicuous flowers clearly require insects, as the stigmas are much beyond the anthers; Fig. 3 shows how, in the cleistogamous buds, they lie in close contact with them, so that they are entirely self-fertilizing.

When the little capsules (Fig. *d*) are ripe, the seeds escape in a curious manner, for they have elastic outer coats which, with the slightest touch, burst, so that the seeds get scattered about.

GENERAL DESCRIPTION OF THE GERANIUM FAMILY.

Herbs; that is, plants with no *wood* in them.

Leaves, with membranous stipules, or none.

Flowers, with whorls in fives; the sepals remaining; the petals overlapping each other in bud; stamens five or ten, sometimes more or less united by their filaments; pistil of five carpels.

This is not a family which supplies us with any very useful products, but many are cultivated for their

* Fig. 1 is very much enlarged. Fig. *a* is about the natural size. Fig. *b* is the corolla from Fig. *a* (with the petals overlapping one another), removed as one piece from the bud, like a cap. It never expands. Fig. *c* is the pistil and stamens removed from the bud (*a*), and considerably enlarged. Fig. *d* is the fruit with sepals remaining, natural size.

beauty. The garden "Geranium," or rather Pelargonium, as it ought to be called, furnishes a great many varieties. They come from the Cape of Good Hope. Many have beautiful *zones*, or bands of colour on their leaves. The garden "Nasturtium," with its large yellow or orange spurred flowers, is a member of this family, the leaves of which are supported in the centre by their stalks, hence they are called *peltate* leaves, i. e. shield-like. Several species of Oxalis, yellow, crimson, and violet in colour, are cultivated; as also the curious Balsams, with very irregular spurred flowers, and of which the capsule bursts elastically into five valves, which screw themselves up on being touched, thereby scattering the seeds to a distance.

THE PEA FAMILY.

THE MEADOW PEA.

The Meadow Pea, blossoming in July and August, the Sweet Pea, or the Garden Pea will do equally well for examination. They all have very weak stems and *compound* leaves, that is, there is more than one blade to each leaf. At the base of the leaf-stalk there are in the Kitchen Pea two large *extra* blades of a different shape from the others; in the Sweet and Meadow Pea, these extra blades are much smaller. They are the *Stipules*. The upper ends of the leaf-stalk are changed into *Tendrils*, but in the Meadow Pea there is only one thread-like tendril, and it is not branched as in the Garden Pea; each of the twisted thread-like branches stands in the place of a small blade or *leaflet*.

MEADOW PEA.

Stanford's Geog.ˡ Estabᵗ

I have already described the stipules of the Violet and of the Geranium, and mentioned the Garden Pea as having very large ones, which look quite like extra leaves. Indeed, they do the work of leaves, supplying the place of those leaflets which are *now* represented by tendrils.

The use of the tendril is to climb with, and so enable the weak stem to stand upright; to do this the leaf is in constant motion, going round and round by *bowing* in all directions, so as to enable the tendril to reach neighbouring objects. As soon as any one of its little branches rubs against a twig, it begins to curl round and round it till it has fastened the pea tight to the twig.

I have said that tendrils have taken the place of leaflets: or we may say that leaflets have turned into tendrils; though this does not, of course, mean that there *ever was* a leaflet where we now see a tendril, but that the little branches of the tendril have grown out just where a leaflet might have been formed. This change of nature of a certain part of a plant in order to do some different work, is not at all uncommon in plants; and it shows a very curious power which Nature possesses of using the same *organ* for several different purposes. Thus we have already seen how stamens and carpels can be replaced by petals in "double" flowers, or even sometimes by green leaves, as in the Alpine Strawberry, proving that they are of the same nature really, but have in ordinary flowers a definite duty, or *function*, as we say, to perform, and so take on a peculiar structure, such as an anther with pollen or a carpel with ovules. So, in the case of the tendril, it

is really a leaf, as you can easily see, but the little blades or leaflets are partly suppressed, while the *mid-rib* which usually runs down the middle of the leaflet is alone retained, and now becomes highly sensitive to the touch. In the Grape-vine the tendril is not in the place of a leaf at all, but of a flowering branch; and it is very sensitive, just as that of the Pea is; but when the branch bears grapes it, of course, does not climb with it, so it has no sensitiveness. You may, however, sometimes find a bunch with only a very few buds, say five or six, instead of a large number; and then its branches are larger, and become more or less like tendrils; showing how one kind of function, that of bearing flower-buds, may be stopped, and then the branch begins to assume the other function, that of climbing. Do not forget to hunt for these different kinds when you next see a Grape-vine.

Now let us examine a flower. The sepals, like those of the Ragged Robin, *cohere* by their edges (see Fig. 1); the five little points show how many sepals there are thus cohering. The corolla is very irregular, the five petals having peculiar shapes, and receiving special names accordingly. Thus, the largest, at the back, is called the *Standard* (Fig. 2); the two below it, one being on each side, are the *Wings* (Fig. 3); while the two lowermost, which cohere slightly along their lower edges, form together the *Keel* (Fig. 4). Removing the petals, you will find ten stamens, one on the upper side being free, while the other nine are coherent by their filaments (Fig. 5), the tips of which, however, are free, as well as the ten anthers. The Petals and the stamens, instead of growing directly from the floral

receptacle, are *adherent* or fastened to the bottom of the calyx. The long ovary of the pistil is shut up within the, so to say, "split tube" thus formed by the filaments. It is prolonged upwards into a *style* which protrudes beyond the stamens and ends with the *stigma* (see Fig. 5). The Pistil consists of a single carpel only.

When the flower fades, the calyx remains, but the petals fall away. The single carpel enlarges, and becomes the well-known pod (called by botanists a *Legume*), while its several ovules turn to Peas (Fig. 6).

If a pea be carefully examined, you will see a little projecting part on one side, and below it an oval scar. This shows where the seed was attached to the pod, while the name *Hile* is given to this spot or scar.

If a pea, bean, or almond be soaked in water, so as to remove the *Seed-skin*, the young plant, or *Embryo* is seen. It will be found to separate into two halves, which are called *Cotyledons*, but which remain attached together at one point, as by a little hinge. A little tail-like projection will be found at the "hinge," and which, when covered by the seed-skin, caused the little elevation above the scar, as seen in Fig. 6; this is called the *Radicle:* it is connected with a minute *bud* which lies concealed in a little depression between the two fleshy cotyledons. This bud bears the name of *Plumule.* All four parts taken together make up the Embryo. You should sow some mustard and cress, peas, and wheat, and other seeds, on wet sand or cotton wool, covering them with a bell-glass, as it is very interesting and instructive to watch the growth of their parts. In mustard and cress the radicle elongates, while the tip lengthens into a root, the radicle *itself*

being the first thread-like stem you see when they are fit to eat. The cotyledons in these two plants are carried up above ground, and turn green, which shows that they are *really* two *leaves;* but while within the seed they were thick, and not at all like leaves, their *function then* being merely to store up food to enable the radicle to grow, until it shall have struck root into the soil, when it would be able to take in fresh food. The little plumule remains idle for some time, and only begins to grow when the seedlings have well rooted themselves; as soon as the plumule starts and shows its *rough* leaves, you then say the Mustard is too old to eat.

In the Pea and Bean, however, things are a little different; for the cotyledons do not come above ground at all; and, instead, the *Plumule* starts first into growth. It is the elongated plumule that you first see coming above ground. The radicle at once developes a root underground, and does not grow into a little stem as in Mustard.

In these plants the embryo has *two Cotyledons* (see Fig. 7), and all Flowering Plants which have two cotyledons to their embryos are called *Dicotyledons.* On the other hand, a great number of plants have only one cotyledon to their Embryos. Hence all such are called *Monocotyledons, Di* being the Greek for *two, Mono* being that for *single.*

You will now understand why these descriptions of plants began with the heading, CLASS I., DICOTYLEDONS (see p. 6); for all plants which bear flowers belong to one or other of these two Classes.

As the blossom of the Pea shows several peculiarities, it will not be amiss to compare it with a Buttercup.

In the first place, the sepals are *coherent* instead of being *free*. The petals are *irregular*, and not *regular*, as in Buttercups. While the latter flower has *many free stamens*, the Pea has only *ten*, of which *one only is free*, the other *nine being coherent*. Moreover, in the Buttercup the petals and stamens grow from, or, as we say, are "*inserted upon*" *the floral receptacle;* in the Pea they are inserted upon, or are *adherent to, the calyx.** Lastly, the pistil of the Buttercup has *several free carpels, each with one ovule.* The Pea has only *one carpel, but it contains many ovules.*

The blossom of the Pea, therefore, teaches us how Nature is able to bring about so much variety in the structure of flowers; for if we suppose a flower to have, say, five free sepals, five free petals, five or ten free stamens, and five carpels, as the Geranium or Wood-sorrel has; then we see how any whorl may vary in *Number*, for the Celandine had but three sepals, and the Wallflower four. Similarly, the petals in the Celandine were about eight, but in the Wallflower only four. Again, the stamens are very many in the Buttercup, six in the Wallflower, and only three in Chickweed.

The next point of difference is in the *Cohesion* of the parts of any whorl; thus the sepals cohere in the Ragged Robin and Pea, but are *free* in all the other flowers described. Moreover, while in all previous cases mentioned the petals and stamens grew out of the floral receptacle, we have now arrived at a new condition in the Pea, in that they spring from the calyx, having grown to it to some extent: this union of two

* I have described the tube as the *calyx*, but it may be *suspected* to be a *receptacular tube*. The same may be said of the Strawberry.

different whorls is called *Adhesion*, to distinguish it from the union or *Cohesion* of the parts of any one whorl. Lastly, any whorl may be *irregular* in *Form* instead of *regular* by having one or more of its parts of a different shape from the others.

Number, *Cohesion*, *Adhesion*, and *Form* are therefore called *Principles of Variation*, and the great variety of flowers and the differences of their structure can almost always be explained by one or more of these four principles.

The Gorse or Furze, the Broom, Rest-Harrow, and two others rather less common, differ from the Pea, Clovers, Vetches, Lucerne, Sainfoin, and other genera of the Pea Family by having *all ten stamens joined* together, instead of there being one free, as in the latter genera.

GENERAL DESCRIPTION OF THE PEA FAMILY.

Herbs, Shrubs, or **Trees.**

Leaves compound, with stipules, and sometimes tendrils.

Flowers with coherent calyx; petals irregular; stamens united into one bundle, or with nine coherent and one free; pistil of one carpel.

Fruit, a Legume.

The Pea Family is one which supplies mankind with more useful *products* than any other family of the whole *Vegetable Kingdom*, which contains some hundreds of families, each, of course, composed of *genera*, and the genera of *species*. It has many very nutritious and wholesome seeds, as Peas, Beans, Lentils, &c.; medicines, as Senna; dyes, as Logwood and Indigo; as well as fibres, timber, gums, resins, and other things too numerous to mention.

STRAWBERRY.

Stanford's Geog.l Estab.t

THE ROSE FAMILY.

THE WILD STRAWBERRY.

The Strawberry plant, which blossoms in May and June, is remarkable for its long runners, which are branches with very long *internodes*, as the parts of a stem between the leaves are called, and which strike root from the *nodes* or joints where the leaves arise. These give rise to buds, which grow up into new plants, finally separating themselves from the parent plant by the decay of the internodes. The same thing occurs in the Creeping Buttercup and in the Violet.

As in the Pea, the calyx of the Strawberry has five coherent sepals, and, in addition, carries five small *bracts* outside (see Fig. 1). They are regarded by some botanists as being *stipules*, for every leaf in the Rose Family has two stipules, so that between each sepal (regarded as a leaf) there are two which have *cohered* to make one of these five bracts. You may sometimes find them *forking*, or showing their two points.

By cultivation, the Garden Strawberry often has the number of sepals and petals increased. The petals are properly five, but the stamens are too many to count. Now particularly observe that the petals and stamens do not rise out of the floral receptacle, free from the calyx, as in Buttercups, but are *inserted upon the calyx*, just as was described in the flower of the Pea, round the border of a juicy *Disk* which secretes honey. This is, therefore, a case of *Adhesion* between different whorls. The pistil resembles that of the Buttercup, for it is also

composed of a great many minute carpels. The receptacle is also raised above the calyx, and when it passes into a fruit, it swells very much, becomes globular, and turns scarlet, while the now ripened achenes—popularly called "seeds"—stand further apart in little depressions, and appear scattered over the juicy red receptacle which you call the *Strawberry fruit.*

Fig. 1 represents the flower seen from below, to show the calyx with the five *stipular* bracts alternating with the sepals.

Fig. 2 is a *vertical section* of the flower, to show how the stamens and petals *adhere* to the dish-like base of the calyx; the elevated receptacle is in the centre.

Fig. 3 is a stamen, and Fig. 4 a carpel, more enlarged than Figs. 1 and 2.

THE ROSE FAMILY—*Continued.*

THE DOG-ROSE.

In June and July we may find the Dog-rose in blossom; it is a woody shrub. It has compound leaves, and stipules like little wings attached to the leaf-stalks.

Observe that the flower-stalk is swollen under the flower; and if you cut the flower down the middle, it will be found that the stalk is really the floral receptacle, but is hollow, and thus forms a cup, called the *receptacular tube* (Fig. 1). The five *free* sepals, the five free petals, and the large number of stamens, all spring from the rim of the cup, which is lined by an orange-coloured disk. The separate hairy carpels, as in the

DOG ROSE.

Strawberry are seed-like, but with long styles (Fig. 2). They are fixed to the bottom and sides of the cup-like receptacle (Fig. 1); so that while in the Strawberry the receptacle is raised into a globe *above* the level of the calyx, in the Rose it is hollowed out of the stalk, *below* the calyx. It forms the scarlet "haw" when ripe (Fig. 3).

It is worth while comparing the Rose with the Apple-blossom, though they will not be in bloom at the same time.

There is in the Apple, or Pear, a thickened top to the flower-stalk, as in the Rose, but it carries five *coherent* sepals, which thus form a sort of saucer on the top, lined with a honey-disk, to which the five petals and many stamens are adherent. Cut this thick receptacular tube across, through the part just below the calyx, and you will find it is not quite so hollow as in the Rose, but nearly filled up with soft *tissue*, in which are embedded the five carpels. This is better seen in the ripe Apple or Pear, in which the star-like "core" (that is, the five carpels, with two pips or seeds in each ovary) is plunged into the juicy tissue of the swollen stalk or receptacular tube. The styles and stigmas are elevated more or less above the level of the calyx, while the petals and stamens are all adherent to the rim of the saucer-like calyx.

When a fruit has the calyx, and often the stamens remaining withered on its summit, as have Apples, Pears, Currants, and Gooseberries, it is called an *inferior* fruit, for it appears to be *below* the calyx. If, however, the ovary has never been sunk into a receptacular tube, it will, of course, remain *above*, and quite free

from the calyx. Such a fruit is called *superior*, and can never carry the withered calyx at the top. Thus Achenes, Siliquas, Legumes, Plums, Cherries, and Grapes are examples, as are all other fruits hitherto described in this book. Such fruits when *juicy* are called "superior berries," while Currants and the like are called "inferior berries"; the special kind, as an Apple or Pear, is called a *Pome*.

Yet another comparison may be made, namely, with the Plum; for this, too, belongs to the Rose Family. Nearly all the genera of which agree in having five sepals, five petals, and a large number of stamens, which, together with the petals, are *adherent* to the calyx. (In the Rose alone are they almost, if not quite, free.) The Plum exhibits a superior fruit of a remarkable kind.

In the blossom of the Sloe, Plum, or Cherry—for they are three *species* of the same *genus*—the calyx has its five sepals coherent, but the little "cup" (the word *calyx* being the Latin for "cup") is quite free from the single carpel which stands at the bottom of it. As the ovary swells to become a Plum, the withered calyx becomes detached at the bottom, and is squeezed off and over the top of the ovary like a cap, and in so doing, though dead and shrivelled, often protects the young ovary from the nipping frosts of spring. When the single carpel has ripened into a Plum, it will be found to consist of a fleshy eatable part, protected by a skin, and having a stony inner part—the three parts, or *layers*, having been formed out of the carpel alone. The *Kernel* is the seed, and *was*, of course, an ovule. Such a "stone" fruit, which is a kind of superior berry, is called a *Drupe*.

BRYONY.

Stanfords Geog.l Estab.t

The Raspberry and Strawberry, both members of this Rose Family, agree in having several carpels, and are also superior fruits; but while in the Strawberry the little carpels dry up, and so cling tight to their single seeds and make achenes, in the Raspberry they form miniature drupes.

GENERAL DESCRIPTION OF THE ROSE FAMILY.

Herbs, Shrubs, or **Trees.**

Leaves compound, with stipules.

Flowers regular; sepals coherent; petals, five and stamens many, both being inserted on the calyx.

Fruits various, achenes, drupes, pomes, &c.

This order furnishes us with several sorts of fruit, as all kinds of Plums, Peaches, Apricots, &c., Raspberries and Blackberries; Strawberries; Apples, Pears, Quinces, and Medlars. Many kinds of Rose, Potentilla, and others are grown for beauty.

THE CUCUMBER FAMILY.

THE WILD BRYONY.

The wild Bryony, which blossoms from June to September, is the only plant we possess of this family in Great Britain. Like the Pea it climbs by tendrils, which consist of one long thread-like piece, which, as soon as it has caught anything, coils up like a corkscrew, but both to the right and to the left. If you count the number of twists, you will find as many go one way as the other.

The first thing you will discover on examining the flowers is that the pistil is never in the same flower

with the stamens, nor even on the same plant. You may easily know the flowers apart by the fact that the *pistillate* flowers stand on little balls, which are the *inferior* ovaries, while there are no such balls to the *staminate* flowers (compare the Flowers of the two drawings on the Plate). Many other plants are in this condition, of having the stamens and pistils on separate plants: thus the common Stinging Nettle, the Willow and Poplar trees, a species allied to the Ragged Robin —all have these organs on separate plants. Others have them in separate flowers, but both on the same plant, as Vegetable Marrows, the Oak and Beech trees, &c.

Let us first examine a staminate flower. The sepals of the calyx are clearly coherent; so are the petals, and, moreover, the corolla is adherent to the calyx. The stamens, which are adherent to the corolla, are joined together in a very curious way; for there are five in all really, but they are united in *two pairs*, together with *a single one free*. Examine the anthers with your lens and you will see they are like the letter S, and have little bright bead-like cells along the edges (Fig. 1). Honey is formed in the middle of the flower, as the pollen must be carried from one plant to another. In the pistillate flowers there are, as observed, no stamens; but the pistil has three styles and stigmas (Fig. 2). The little green balls below finally become scarlet berries when the fruit is ripe.

Cucumbers, Melons, Pumpkins, Gourds, and Vegetable Marrows all belong to this family, and have the stamens and pistils in separate flowers, but not always on separate plants. Thus, in the cucumbers and melons, both pistillate and staminal flowers grow on the same plant.

Gardeners usually pluck off the flowers with stamens, and dust the pistils of the others with them. People who do not know how important it is to do this, sometimes wonder why they get no fruit when the plants are grown in closed frames into which bees cannot get access; for these insects will *cross* the flowers when they can come for the honey.

It is worth while studying the structure of the fruit of a cucumber as seen in a cut slice. The six edges of the three carpels first meet in the middle so as to divide the ovary into three chambers; but they then grow outwards, and finally turn inwards again when they have arrived near the outer wall, so that the seeds attached to the edges point inwards, giving an anchor-like appearance to them. The chambers get filled with pulpy tissue, in which the seeds are embedded.

GENERAL DESCRIPTION OF THE CUCUMBER FAMILY.

Herbs climbing by tendrils.

Flowers with stamens or pistils only.

Stamens coherent all together, or in groups of twos, with one free; anthers S-like.

Fruit an inferior berry, or *Pepo*, as Gourds are botanically named.

A great number furnish useful food, as those mentioned above. Some are very bitter, such as the Colocynth, or Wild Vine of Scripture. It is a useful medicine, and may often be seen in chemists' windows, resembling peeled oranges dried.

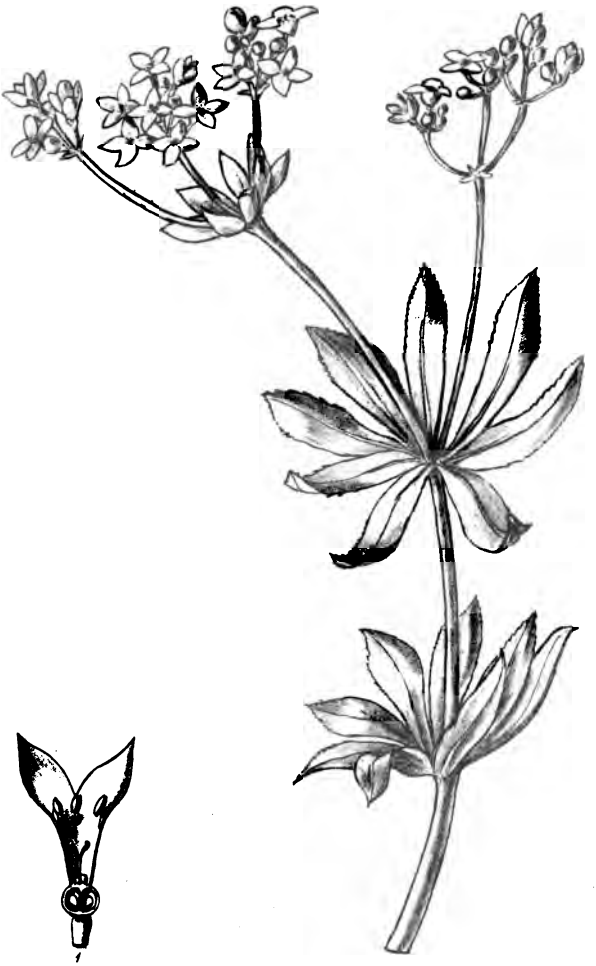
Fig. 1 shows two stamens joined together, and Fig. 2 is the pistil, with the calyx and corolla removed. Both Figs. are enlarged.

THE MADDER FAMILY.

THE WOODRUFF.

This family is a very large one, principally growing in hot countries, and contains the Coffee-tree and the Cinchona, which gives us the medicine so useful in fevers, called quinine. It is divided into *Tribes*, one of which—the STELLATE TRIBE—embraces all our British plants which belong to this family. We have but four genera, namely, one species of Madder, several of Galium, the Woodruff, and the Blue Sherardia. Notice how the leaves are all arranged in whorls like stars. This is why the name *Stellate*, from the Latin word *Stella*, a star, has been given to them.

The globular inferior ovary with two cells and the funnel-shaped corolla, are easy to be seen (Fig. 1); but there is no visible calyx. If it had been present it would have been *on* the top of the ovary just below the corolla; but as it has not grown at all, the calyx is said to have been *arrested*. Four stamens adhere to the corolla; and a single style, arising from the middle of a cup-like honey disk, and ending above with two branches, complete the flower. In the Madder and Galium the corolla has no funnel-shaped tube, but it somewhat resembles a little five- or four-toothed *wheel*, and is hence said to be *rotate* in shape, from *rota*, a wheel, in Latin. All four genera form fruits resembling two little balls joined together, and one species of Galium, called "Cleavers," has its fruits covered with hooked bristles.



WOODRUFF.

Stanford's Geog.l Estab.t

DANDELION.

Stanford's Geogl Estab.t

GENERAL DESCRIPTION OF THE STELLATE TRIBE OF THE MADDER FAMILY.

Herbs. Leaves in whorls.

Flowers minute, but clustered together; parts in fours or fives; calyx often arrested; corolla regular.

Fruit of two coherent "nutlets."

The plants most useful to us are undoubtedly the Madder, Coffee, Cinchona, and Ipecacuanha. The Madder yields the red dye of this name. If animals be fed upon the plant, their bones become red! The Coffee bears a brown-red berry, with two seeds in it. It is the seeds which are roasted, and which we wrongly call "berries." It comes from Arabia and Africa, but is grown in Ceylon and elsewhere. The Cinchona trees grow in the mountainous regions of the north-west of South America. Ipecacuanha, like Quinine, is a valuable medicine. Several have very beautiful flowers, and are much prized for their beauty or scent, such as the Gardenia.

THE COMPOSITE FAMILY.

THE DANDELION.

This plant and the Daisy belong to one of the largest of families; and for comparison get as well—as each blossoms in its season—a Thistle, a Cornflower, and the Garden Marigold. Let us begin with the Dandelion, which is one of the earliest, blossoming from May to June.

You see a quantity of green *bracts* below the yellow flowers. These are not sepals, because it is not a single

flower, but *composed* of a dense mass of small but perfect flowers. Cut the *Head*, as it is called, down the middle. You can then break it up, and pick out the several flowers or *florets*. Take one from the outside (Fig. 1), and observe the following facts. The ovary is *inferior*, seemingly forming a support to the flower. On the top you see a ring of hairs; this stands in the place of the calyx, and is called the *Pappus*, and forms afterwards the *Down* of the achene-like fruits (Fig. 2). The corolla rises from the top of the ovary, from within the hairs, as a tube, but soon spreads out like a *strap* to one side, and ends with five little points, which show that it has five coherent petals. There are five stamens; their filaments grow quite freely from one another, but spring from—that is, are adherent to—the tube of the corolla. Their *anthers* are very long, and *all five cohere together into a tube or cylinder by their edges*, through which the style, by gradually going upwards, pushes its way, and so sweeps the pollen upwards and out at the top of the anther-tube, which then falls upon other stigmas of the florets around, or is carried from plant to plant by bees. The two stigmas then separate—for they had previously stuck together, and so prevented the pollen from touching them—and look at first like the letter Y, the arms of which soon curl back, so it assumes the appearance of miniature ram's horns.

All the little florets are exactly alike; and you now see and can understand why the Dandelion is not a simple flower, as it is *composed* of many florets, and this is why the family is called the *Composite Family*.

The Thistle differs from the Dandelion in that the

florets are all little tubes, with a regular *five-toothed border*, and not *strap-shaped*. Indeed, the florets of the Dandelion only differ in the tube being split down and flattened out. The stamens and pistil are constructed exactly in the same way.

In the Cornflower they are all tubes like the Thistle, only those on the outside are very much larger than the rest, and will be found to contain no stamens nor pistil at all.

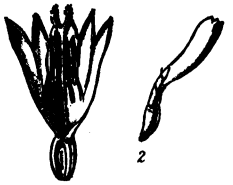
When the head of a Dandelion becomes a mass of ripened fruits, a good many changes take place. First, the bracts, instead of being erect, *all* curl backwards, like the lower ones in the drawing. The corollas fall away, and the short, neck-like piece between the ovary and pappus of Fig. 1 grows and grows till it becomes like a tall, slender rod, and carries the pappus on the top, now spread out *flat* like a chimney-sweeper's brush (Fig. 2). The ovary has now several little pointed projections which have grown out upon its surface, and which serve as anchors to retain the seed when it falls on the ground, or amongst grass, &c. There is only one seed in each ovary. As soon as it is ripe a puff of wind will detach these little fruits, and they fly away to great distances like natural parachutes.

THE COMPOSITE FAMILY—*Continued.*

THE DAISY.

In the three flowers just described, the Dandelion, Cornflower, and Thistle, the whole of the florets are of the same colour; but in the Daisy there is a manifest difference between the outer white florets and the central yellow ones. Of course you will not now imagine the green bracts outside to be sepals, nor the white florets, petals only, nor the yellow ones, stamens only; for it is not a simple flower, but a *head of florets*, and the ones on the outside are called *Ray*-florets, those in the middle *Disk*-florets. The Ray-florets have strap-shaped corollas like the Dandelion (Fig. 2), but the disk-florets are tubular, like those of the Thistle (Fig. 1). The Ray-florets, however, have only *three* petals instead of *five*, to make the strap with, and, moreover, they have no stamens, but only a style with two stigmas. On the other hand, those of the "eye" or disk-florets are quite perfect, that is, they have both stamens and pistils, as shown in Fig. 1, in which the corolla is laid open to exhibit the stamens attached to it within, and the style passing up the centre. The ovary is supposed to be cut open to show the single erect ovule in the chamber. The figure is much enlarged.

If we compare the garden Marigold with the Daisy, we shall find that the ray-florets are like those of the Daisy, having pistils without stamens, but the disk-florets have stamens only: they have a style and a globular, not forked, stigma, it is true, but they cannot



DAISY.

Stanford's Geog.l Estab.t

set seed. The use of the club-like stigma is simply to push the pollen out of the anther-tube, or it would never get dislodged.

I have said just now that this is one of the largest families. Indeed, there is scarcely a country where plants will grow at all, that does not contain some one or more. The structure of the flowers of all, however, is the same in the details just given, and can therefore be easily recognized. You must not, however, jump to the conclusion that every plant which has its flowers in heads *must* therefore be a composite; for the prickly Teazles and the Scabious of our fields have heads; but you will notice at once that in these plants the *anthers are quite free*, and stand out above the florets very conspicuously; whereas in all composites the *anthers are coherent together*. This is the most obvious feature which separates the Composite from other families.

GENERAL DESCRIPTION OF THE COMPOSITE FAMILY.

Herbs, mostly with alternate leaves.

Flowers, composite in heads, surrounded by bracts.

Florets with an inferior ovary, bearing a pappus above or not. Corollas all strap-shaped, as in Dandelion; or ray only strap-shaped, as in Daisy: or else all tubular, as in Thistles; or the disk-florets only tubular, as in Daisy; stamens with anthers coherent.

Fruit achene-like, with or without the down or pappus.

A great number of species are cultivated as garden plants, such as the Dahlia, Aster, Marigold, Chrysanthemum, and "double" Daisy. A "double" composite is a very different thing from a double Buttercup, or other flower; for while the latter is only one flower,

with petals in the place of stamens and carpels, a double Daisy is a head of florets, and the change undergone is that the little yellow florets of the eye, or disk, have turned into strap-shaped corollas like the ray-florets, giving the appearance of a mass of petals, like a Bachelor's Button, but being really of a very different origin.

Some species are grown for food, such as the Jerusalem Artichoke, the true Artichoke, the Cardoon, Salsafy, and Endive, which is a species of Chicory. The root of the real Chicory is like a carrot, it is cut into slices, roasted and ground to powder, and used for mixing with coffee. It may be easily known from coffee by laying a teaspoonful on the surface of *cold* water, when it *rapidly colours* the water, while pure ground coffee is a long time in giving a dark colour.

THE HEATH FAMILY.

THE SCOTCH HEATH.

This common Heath, which blossoms in July and August, is well known as the plant which makes our moors and hill-sides so beautiful. It is generally mixed with another kind, but less abundant, called the Cross-leaved Heath, the blossoms of which are rather larger and pinker; while a third plant, the Scotch Ling, with very small pink flowers, forms patches intermixed with the former.

Either of the kinds of Heath will do for examination. The sepals are four, and very small. The peculiarly inflated corolla, with its little teeth, is very

SCOTCH HEATH.

Stanford's Geog.l Est.

characteristic of the Heath Family, while the eight stamens *quite free from the corolla,* is a feature very rarely seen with flowers having coherent petals (Fig. 1). For, when any flower has its petals coherent, the stamens are almost always adherent to the tube thus formed. The Heath and the Campanula Family are the chief exceptions. The anthers are very peculiar. They burst by holes or *pores* at the top, and have little fringed *tails* behind (Fig. 2). Lastly, the pistil is quite free in the centre, and is composed of four carpels. It forms a capsule when a ripe fruit, which bursts into four valves, leaving a central column in the middle which carries the seeds, as shown in Fig. 3.

The use of the tails to the anthers is as follows:— The anthers are at first set closely round the style, so that their tails spread out horizontally, while each little pore of the anther-cells, through which the pollen will escape, is at first closed, by pressing upon the pore of the next anther-cell; so in this condition every pore is closed by the neighbouring pore of the next anther pressing against it. Hence the pollen cannot fall out though the flower hangs downwards. If, now, a slight pressure be made upon one or more of the tails, the other end of the anthers is raised, and the whole of them soon separate, and the pollen falls out and upon the bee's head, if it be supposed to have done it. The stigma projects outwards, and will strike the bee just where the pollen will have fallen upon it from a previously visited flower.

GENERAL DESCRIPTION OF THE HEATH FAMILY.

Herbs, Shrubs, or **Trees.**

Flowers mostly regular, and often with inflated

corolla; stamens free from the corolla, with anthers opening by pores, and often bearing tails.

Fruit, a capsule or berry.

Many of this family are cultivated as ornamental plants, such as the Rhododendrons, with slightly irregular flowers; the Arbutus, or Strawberry-tree, found wild in western Ireland. A great many species of very beautiful Heaths from South Africa, are grown in conservatories, the corollas often having a wax-like appearance. One genus differs from all the rest in having an *inferior berry*. It is the genus which contains the Cranberry and Bilberry, both of which are very good to eat, but the family are not of much use otherwise. One species of Heath supplies wood for what are called Briar pipes, the word *Briar* being a wrong pronunciation and spelling, for the French word *Bruyère*, meaning Heath.

THE POTATO FAMILY.

THE WOODY NIGHTSHADE OR BITTERSWEET.

This plant is remarkable as being the very feeblest of *Climbers*. Its slender shoots can just twine themselves round objects such as nettle stems, &c. In fact, when it grows freely in a hedge, it can hardly be said to climb at all. I have already had occasion to speak of weak-stemmed plants climbing by tendrils, as the Pea and Vine, but not before of *twiners* or *stem climbers*. Much better examples of these than the Bittersweet are the Bindweed or Convolvulus, the Hop, and Honeysuckle. It is an interesting thing to notice how a shoot keeps bowing in all directions, sweeping round

WOODY NIGHTSHADE.

Stanford's Geog.ˡ Estˢ

and round in large or small circles, searching for an object as a support, against which, as soon as one is found, the twining stem presses itself, and then climbs up it spirally by merely continuing to bow. You can easily imitate it by holding one end of a piece of string in your left hand and the other end in your right, and then make your right hand describe circles above the left. Now let someone else hold a rod in front of you, and you will find the string winds itself spirally round it as you make it describe circles.

The shoots of the Hop take between two and three hours to complete a circle, so that although you cannot *see* it move, if you note the direction in which it is pointing, say, at ten o'clock in the morning, look at it afterwards at noon, and it will be pointing in a quite different direction.

We will now resume our observations on the Bittersweet. Note how the flower-stalks spring from the middle of an internode instead of from an axil of a leaf. This is due to the fact that the stalk is united to the stem for a considerable distance above the leaf.

The calyx is very small, but bears five distinct points, showing that there are five sepals (Fig. 2). The purple corolla is clearly in one piece, and carries the five stamens, with rather large and prominent anthers in the middle. These are somewhat united together, so as to make a sort of cone; and, instead of bursting by slits, they open by round holes or pores at the top, as in the Heath (Fig. 1). The slender style passes up and out of the middle of the anthers (Fig. 2). There are only two carpels, coherent, which later become the oval scarlet berries, as seen in the lower part of the drawing.

The only other wild species we have is the Black Nightshade. It is a herb growing in waste places; has small white flowers, and round purple berries.

GENERAL DESCRIPTION OF THE POTATO FAMILY.

Herbs, often with a poisonous juice.

Flowers regular, bell-shaped or rotate; the whorls in fives; stamens adherent to the corolla.

Fruit, a two-celled capsule or superior berry, with many seeds.

This family contains several useful plants, but almost all are poisonous. Still some of these give us useful medicines, such as the Tobacco, the Henbane, and Belladonna, the dark purple berries of which have often poisoned children. On the other hand, the Potato from South America, and the berries of the Tomato and Capsicum, which furnishes us with the hot-tasting chillies and cayenne pepper, are exceptions to the rule of the family being poisonous. One plant, about which very absurd stories are told, is the Mandrake. It is another species of the same genus as the Belladonna. The root is forked like a badly-grown carrot; hence it was supposed to have some appearance to a man, and it was thought that when it was pulled up it groaned and shrieked, and whoever heard the shriek or groan would die; if, however, the plant could be secured it would be a charm against demons. The way to get it was to dig a trench carefully round the root so as not to injure it; the bunch of leaves on the top of the root was then tied to the tail of a dog, which was whipped, when his cries helped to drown the groan, and on its trying to escape, up would come the Mandrake! When you are old enough to read Shake-

PRIMROSE.

Stanford's Geog.l Estab.t

speare's plays, you will see that he more than once speaks of the Mandrake. Thus he says :—

> "Shrieks like mandrakes' torn from the earth,
> That living mortals, hearing them, run mad!"

Tobacco is a plant which has been smoked for ages in America. It was brought to England about the year 1560, by Sir Walter Raleigh, from Virginia. It met with extraordinary opposition in Europe. The Sultan forbade its importation into Turkey, and condemned to death all guilty of smoking. So did the Grand Duke of Moscow; or, as a milder punishment, smokers should have their noses cut off! Our own King James wrote a book against smoking. Notwithstanding all this, smoking has become quite general.

Of all plants of this family the Potato is the most useful. It grows wild in South America, but the *tubers*, or potatoes, are very small, not much bigger than nuts. The large size they now have is due to careful cultivation.

Their usefulness consists in the great quantity of *Starch* they contain, which, though not very nourishing in itself, makes them valuable as a vegetable with meat.

THE PRIMROSE FAMILY.

THE PRIMROSE.

As the Primrose is one of the earliest of flowering plants, blossoming in April and May, it is a good example to study well. You must dig it up by the roots, and you will find it has a thickish, rugged under-

ground stem, called a *Rootstock*. From this spring the cord-like true roots. From the top of the stem grows a tuft of leaves; and as they *seem* to rise up from the root (but you must understand that the rootstock is *not* a root but a real stem) such leaves are called *radical*. Similarly, the flower-stalks rise from the root-stock.

Now let us examine a Flower. The tube-like calyx has five tapering points, which show that it is composed of five *coherent* sepals. Cut it open and you can remove it, leaving the rest of the flower untouched. The corolla consists of a slender tube with five broad, notched petals, which together make the *limb* of the corolla, each of the five pieces being called a *lobe*. Look down the tube from above, and observe whether you can see five anthers, or whether you see a globular stigma instead; for if you gather blossoms from several different plants, you will soon discover that some bear flowers which are like Fig. 1, while other plants have them like Fig. 3. In the first, the stamens are situated just at the entrance to the tube, while in the other kind the stamens are much lower down. The lengths of the styles of the pistils also differ; for in the first case the stigma is low down, for the style which bears it is short, while in the latter it is as high up as the style is long. Now, place one of each kind of flower side by side, and you will find the stigma of the one stands exactly on a level with, or at the same height as, the stamens of the other. Hence, when an insect comes to search for honey, its proboscis gets dusted with pollen on a certain spot, and then flying away to another flower, the stigma will now rub

exactly against the spot where the pollen has been deposited from the first flower.

There is another point to be noticed, and that is that each stamen is fixed immediately *in front* of a petal, not *between* the lobes or petals of the corolla, as in other flowers; for the rule is that the parts of each whorl of any flower should *alternate* with the parts of the next whorls, but the Primrose Family is an exception. The explanation is that there ought to be *two* whorls of stamens of five each, for you will remember we had *ten* stamens in Ragged Robin, Geranium, Pea, and others; but one of these whorls has not grown at all, or, as botanists say, has been *arrested*, so that the next whorl, i. e. the whorl of stamens now present, are in front of the petals.

If we represent the parts of a flower as follows, as if it were cut open and spread out, you will see how it happens. Let S stand for sepal, P for petal, St for stamen, and C for carpel.

S		S		S		S		S	
	P		P		P		P		P
*		*		*		*		*	
	St		St		St		St		St
C		C		C		C		C	

The * * stand where an outer whorl of stamens *ought* to be, but are wanting, so that the second whorl of stamens (St) are now in front of the petals (P).

The pistil has another peculiarity besides the one mentioned, in that the ovary is only one-celled, but carries a ball-like *placenta* in the middle, the surface of which is covered with ovules, just as has been already described in the case of the Ragged Robin and Stitchwort. Cut the ovary across, and you will see it as

represented in Fig. 2. Moreover, as the stigma is quite globular, I cannot tell you of how many carpels it is composed; still, as the fruit forms a little capsule in almost every member of the Primrose Family, and often opens with five little teeth, as shown in Fig. 4, we may *suppose* that there are five carpels really; but there is nothing else to indicate the number.

Though the capsule of the Primrose and many others opens by little teeth, which curl back to let the seeds drop out, that of the Scarlet Pimpernel or "Poor Man's Weather-glass"—a common corn-field weed, with opposite leaves and small, bright scarlet flowers—bursts in a very different manner, for it cracks all round, and the top comes off like a lid. The capsule of the Henbane of the Potato Family, as also that of the common Plantain, on the seeds of which we feed our canaries, splits in the same way. As they thus look like little boxes, botanists have called them by the Greek word for a box or *pyxis*.

General Description of the Primrose Family.

Herbs with opposite or alternate leaves.

Flowers regular; the petals with a stamen in front of each.

Fruit a capsule opening by teeth or splitting all round, with many seeds on a *free-central placenta*.

The Primrose and Cowslip (the flowers of which agree with the Primrose in the particulars mentioned) may sometimes be found with pink or crimson-coloured flowers. These varieties have been cultivated, and thereby much improved in size and colour, the Cowslip being then called Polyanthus. The Garden Primrose is mostly *double*—that is to say, the stamens and pistil

have become replaced by a bunch of petals, so that the corolla looks something like a miniature rose. The Oxlip, found in several parts of England, is supposed to be a *hybrid*—that is to say, the pollen of a Primrose has probably fertilized the pistil of a Cowslip, or else that of a Cowslip has fertilized the pistil of a Primrose, because the Oxlip resembles the Cowslip in having what is called an *umbel* of flowers, or a number of flowers on little stalks, all of which are borne at the top of a larger one. It, however, has a much larger corolla than the Cowslip, and so more resembles a Primrose. It is thus like a Mule, which is the offspring of a horse and an ass, but differs in that a Mule bears no offspring. It more nearly resembles so many of our pheasants, which are said to be often *hybrids* between two or even three kinds or species, and all lay plenty of eggs.

Several other plants of the Primrose Family are cultivated in flower-gardens, such as the Auriculas, with their powdered-looking leaves, as well as other species of Primrose. Then there is the pretty Cyclamen, which carries its pink and white blossoms upside down, the long petals being twisted behind. Several very pretty small-flowered species are Alpine plants, one of the prettiest of which is called *Soldanella*, and has blue flowers with fringed petals, often grown on rockwork to imitate its original home on the Alps of Switzerland.

THE LABIATE FAMILY.

THE WHITE LAMIUM OR DEADNETTLE.

The White Lamium, blossoming abundantly in May and June, is generally called Deadnettle, because the square stem and opposite leaves, as well as their shape, resemble the stinging nettle; but unlike that plant this does not sting. The flowers are totally different, and indeed the two plants have nothing to do with each other, being of quite different families.

The Lamium has a long, creeping, *perennial* underground stem, from which the *annual* flowering stems arise. The flowers are produced in dense clusters in the *axils* of the leaves, and look as if they formed a ring or whorl round the stem, hence they are called *False-whorls*, but no flowers grow from *between* the two opposite leaves.

Pick out a flower. The calyx is like a little funnel with five pointed teeth. It is therefore made up of five *coherent* sepals. The corolla is decidedly irregular, and it is a little difficult at first to find the individual petals; but if you remember the rule, mentioned in describing the Primrose, that petals should alternate with the sepals, you will see that the notched front piece or *lip* of the corolla, as it is called, stands just *between* the front sepals. Hence the lip, though cleft, is really *one* petal. Next, observe the two little points, one on either side of the tube of the corolla. These stand over the spaces between the sepals at the sides; hence each point stands for a petal. Lastly, as there is one sepal exactly at the back, the hood-like petal,

WHITE LAMIUM.

Stanford's Geog^l Es

which you might very likely think was only *one*, is really composed of *two;* so that now we have the right number, five, complete. As all the flowers of this family have the *lip*, the family is called "Labiates," or *lipped* flowers.

We must next examine the stamens. There are only four, and they are adherent or fastened to the tube of the corolla. You will find that two are longer than the other two, and if you trace the filaments down from their anthers to their points of attachment, you will find the longest come from the front, and the shorter spring from the back. There ought to be a fifth, which should lie up the back along the middle of the hood, but this stamen has not grown at all, or has been *arrested.* Observe how the two anther-cells of each stamen, though side by side at first, get separated when they burst, because the upper part of the filament which lies *between* the two anther-cells is very much enlarged. Indeed, the two cells stand almost end to end in consequence. This piece which causes them to separate is called the *connective*, and was described when speaking of the Lesser Celandine. Fig. 1, which is half of a flower cut down the middle, will help you to observe all these details mentioned.

The Pistil is peculiar. The ovary is deeply *four-lobed*, and the best way to see it is to look down a calyx of one of the older flowers from which the corolla has fallen, and you will see the round ovary with a cross-like cleft in it. Now give the calyx a squeeze at the bottom, and you will throw out the four *nutlets*, into which the deeply four-lobed ovary is now broken. Fig. 2 shows the four ripe nutlets. The style usually

comes away with the corolla, but by carefully opening out the tube of the corolla of a flower while it is within the calyx, the slender style with its forked stigma will be seen lying between the filaments, as shown in Fig. 1.

The flower, being so irregular, is clearly adapted to insects. The lip forms an excellent landing-place, and the head of the insect being thrust under the hood in which lie the anther-cells, it gets easily dusted with pollen, while the two little tongues of the stigma are ready to "lap up" the pollen, so to say, from the bee's head or back, which it has already collected from some other flower.

The flower of the plant called Salvia, several kinds of which are often grown for their beauty, for there are red, yellow, blue, and white flowering species, is most peculiar in its structure; for though it agrees with the Lamium in the calyx, corolla and pistil, there are only *two* stamens instead of *four*. The filaments are very short indeed, but they carry, *swinging* upon their tips, long *filament-like* processes, which you might readily fancy were the real filaments themselves; but you will find that they each carry only one anther-cell, at the top, which produces pollen, under the hood; while the other anther-cell is at the other end, at the bottom, overhanging the entrance to the tube of the corolla, and is like an empty spoon, and produces no pollen. This long process is the *connective*, it is the same thing as described above in the Lamium, only now enormously elongated, and forming with the filament something like the letter T, the upright stroke being the filament, the cross-bar is the con-

nective, and the two ends of the letter may stand for the anther-cells. What is the use of all this? If you imitate a bee by pressing down upon the two lower empty anther-cells with a pencil, you will find the other pair immediately swing forwards and downwards and strike the pencil, dusting it with pollen. Had it been a bee, the insect would have received a blow on her back, with the addition of a shower of pollen! Flying away, the anthers recover their position under the hood. The stigma projects forwards, and is situated so as to hit the bee's back on her entering, just where the pollen has been deposited from a previously visited flower.

GENERAL DESCRIPTION OF THE LABIATE FAMILY.

Herbs with square stems.

Leaves opposite and scented.

Flowers in false whorls; corolla *labiate;* stamens, four, two longer than two, or two only; ovary deeply four-lobed, with a slender style and forked stigma.

Fruit of four nutlets.

Most of the genera of this family are peculiar for the strong scents they possess. These are produced by little glands filled with oil in the foliage and elsewhere, so that many of them are useful; several, such as Thyme, Sage, Basil, Mints, &c., are employed as kitchen herbs; others, such as Patchouli, Lavender, Rosemary, Peppermint, &c., for their scents; but none are poisonous.

THE BUCKWHEAT FAMILY.

THE BISTORT OR SNAKE-WEED.

A great number of plants have no corolla, and sometimes even no calyx, so that they are then said to be *incomplete*. The Bistort, blossoming from June to October, the Nut or Hazel, and the Willow, are selected to illustrate this group of plants with incomplete flowers.

The first point to notice is the *membranous sheath* surrounding the stem at the bottom of the leaf-stalks. This is composed of stipules. The flowers are brightly coloured, but it is only the calyx, there being no corolla at all. It is not an uncommon thing for the calyx of a flower to be coloured, instead of, or as well as, the corolla. Thus, the Marsh Marigold, which resembles a large Buttercup, has a bright yellow calyx, but no corolla; so, too, the bright-flowered garden Anemones and Clematis have no corollas. In the Larkspur and the Monkshood the petals are only two in number, but still these blue flowers are mostly indebted to the calyx for their conspicuous appearance.

The stamens of the Bistort are eight in number, and at the base of the filaments are little glands which secrete honey, as this species, being conspicuous by the number of flowers grouped together, attracts insects. Fig. 1 represents the calyx and stamens laid open, and shows the gland at the base of each filament. Fig. 2 is the pistil, with its three slender styles, which indicate the number of carpels; and Fig. 3 is the three-

BISTORT.

Stanford's Geog.l Estl

cornered fruit, similar in shape to that of the Buckwheat.

GENERAL DESCRIPTION OF THE BUCKWHEAT FAMILY.

Herbs with swollen nodes.

Leaves with membranous sheathing stipules.

Flowers with calyx, green or brightly-coloured, and no corolla; stamens free or adherent to the calyx.

Fruit, a one-celled, one-seeded, three-cornered nutlet.

There are several species of *Polygonum*, the Latin name of the genus to which the Buckwheat and Bistort belong. Another is called Knotweed, and grows on almost every piece of waste ground. In this species there are no glands in the tiny, pinkish-green flowers, and the stamens curl over the stigmas, so that these little inconspicuous flowers are quite self-fertilized.

The Buckwheat, much cultivated on the Continent for its seeds as food for poultry, &c., has two kinds of flowers, some with long stamens and short styles, others with short stamens and long styles, just as in the Primrose; so that an insect visiting either kind of flower gets first dusted with pollen in a certain spot on its body, which is afterwards exactly touched by the stigmas of the other kind of flower when the insect visits it.

The three-cornered little fruit of the Buckwheat is full of nourishment, and useful for feeding poultry.

The Common Docks all belong to this family, of which the Sorrel is a species. This plant has an agreeably acid flavour, due to the presence of a very poisonous substance, called *oxalic acid*. This is con-

tained in a white powder, sold under the name of "Salts of Lemon." It is useful for removing ink-stains, but it is poisonous.

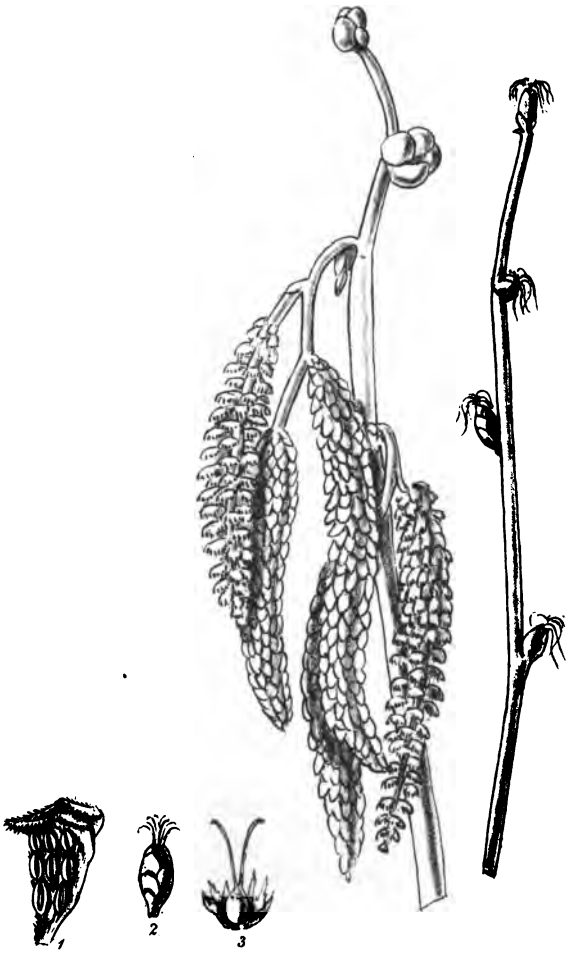
Rhubarb, of which the stalks of the leaves make excellent tarts and jam, grows wild in Thrace; but the species which gives us the useful but very disagreeable medicine is the root of one which grows in the north of China.

THE CUP-BEARING FAMILY.

THE HAZEL.

Of this family there are the following trees in Great Britain: the Hazel or Nut, the Hornbeam, the Oak, the Beech, and the eatable Chestnut, introduced from the Continent.

These trees have all got *stipules*, but of a peculiar kind. I have often spoken of stipules, which, you will remember, are appendages found at the base of the leaf-stalk, as of the Violet, Pea, and Rose. On the Pea they are very large, and sustain all the functions of leaves. In some plants they protect the little bud in the axil of the leaf, as in the garden Geraniums. But in the oak and other of these trees, their use is as *bud-scales* to protect the delicate parts within from the frosts of winter. As soon as the buds burst open in spring the scales fall off, or are said to be *deciduous*, having done their duty, so that you might easily fall into the mistake of supposing these trees to have no stipules, as you may not find them, except for a short time only, and by the side of the very youngest leaves.



HAZEL.

Stanfords Geog.ˡ Estᵃ

People sometimes fancy that these trees never blossom. It is true they never have large, conspicuous flowers, but they could not bear nuts, acorns, &c., if they had no flowers. You must often have seen things like long tails hanging from a nut-bush, oak, or willow. These are called *Catkins*, and are made up of a great number of green bracts or scales, overlapping one another like tiles on a roof. Though you may see them in the winter, they do not open till March and April. Each scale has two smaller ones underneath it, together with eight stamens. Each stamen, however, bears only one anther, as shown in Fig. 1. Though there are eight in all, quite separate, they probably represent only four really; each stamen having grown up, as it were, split in half. The Hornbeam, a common tree in Hertfordshire and at Epping Forest, agrees with the Nut in only having bracts, and no true calyx, protecting the stamens, which in this genus are only partly divided, the two anther-cells being separated, but both are supported on one and the same filament.

To find the pistils, you must examine carefully the little tuft-like buds on the sides and ends of shoots of the Nut-tree (see Fig. 2). You will easily know them from leaf-buds by their having little crimson threads protruding from their ends. These threads are the long styles, two of which belong to each pistil, while every pistil stands for a separate flower.

If you can manage to remove the little round scales which make the bud look like a tiny fir cone (Fig. 2), you will find that each pistil within it is surrounded by one or two small bracts, as shown in Fig. 3.

When these little buds become fruits, the outer scales

fall off, the inner bracts grow into the large leafy "cups" which envelop the *nuts* into which the pistil has now turned; so that the cluster of nuts, each in its leafy cup, often four or five together, which you find in autumn, were *all* included in the little cone-like bud you examined in spring.

As all the other trees mentioned above, as well as others of two or three different families, have catkins, these families are sometimes grouped together, and called the *Catkin-bearers.*

In the Oak, Beech, and Chestnut, each separate staminate flower of the catkin has a true calyx, and not merely a bract or scale protecting the stamens. The pistils are always in separate flowers, but *on the same tree* as the catkins. In the Oak and Beech the pistil has three carpels united together with *three* cells in the ovary and *six* ovules; but when they become fruits, only *one* ovule becomes a seed. The fruit of the Beech is called a Mast, of the Oak, an Acorn, and Sweet Chestnut that of the Chestnut-tree. They all have cups. In the Nut and Hornbeam it is *leafy*, but in the other three it is *woody*. In the Oak the cup is round, and made up of a great number of small bracts all united together. In the Beech, it is much the same, only the cup is divided into four hard, rough divisions. In the Chestnut it is also divided, and covered with strong prickles.

You must be careful to distinguish, I mean *botanically*, an eatable Chestnut from a Horse-chestnut. The former is a true *fruit*, and contains a seed within it; the outer smooth brown *fruit-skin*, closely fitting upon the inner paler brown *seed-skin*; whereas the bright,

shiny brown horse-chestnuts are *seeds* only; the *fruit*, corresponding to the outer skin of the eatable chestnut, is the large green ball which splits into three pieces as it falls to the ground, when the ripe, polished-looking chestnut *seeds* fall out.

GENERAL DESCRIPTION OF THE CUP-BEARING FAMILY.

Trees or **Shrubs.**

Leaves, with deciduous stipules for bud-scales.

Flowers, the staminate in catkins, the pistillate separate from these, but on the same tree.

Fruit, a nut, acorn, &c., surrounded by a leafy or woody cup. The seed contains a large embryo.

This family, which is mainly composed of trees, furnishes us with very valuable timber, especially the Oak, of which there is a great number of species, principally in North America. The bark is valuable, for it contains a substance called *tannin*, with which skins are tanned, and become leather. Tannin has a strong "liking" for iron, and when any solution of iron is mixed with powdered oak bark, it makes black ink. Iron being so common in soils, especially seen as *iron-rust* whenever sand or soil is *red*, if oak trees lie buried underground for many years they often turn quite black all through. A great deal is found in Ireland, and called "Bog Oak." The black wood is often used for bracelets, and ornaments of various kinds, and made into walking-sticks.

THE WILLOW AND POPLAR FAMILY.

THE WILLOW TREE.

As we have now fair-sized trees to consider, it will be a good opportunity to say a few words about the structure of stems. If you examine the cut end of the trunks of any of our English trees, you will easily observe the following features:—First, there is the *Bark*, which can be removed from the *Wood* without much difficulty. The wood exhibits a quantity of *rings*, these being rather harder lines which mark off each year's growth, the oldest being in the middle, the youngest just under the bark. In the centre can sometimes be seen very plainly, as in the Elder, the *Pith*; but in most trees it is too small to be seen without a lens. Now these three parts, *Bark*, *Wood*, and *Central Pith*, are found in all trees of the Class Dicotyledons, and is another character by which they may be known, as well as that taken from the embryos, as explained at p. 34. There is yet a third, which will be spoken of hereafter, p. 76.

Like the cup-bearing family, Willows and Poplars have stipules, which are deciduous in many cases, but sometimes *foliaceous* or leaf-like, and then they remain on the boughs.

Willows and Poplars, which blossom in April and May, and which together make one family, differ from all the plants hitherto considered (the Bryony only being excepted), in having the stamens, not only in separate flowers from those which contain pistils, but in bearing these two kinds of flowers on separate trees.

SALLOW WILLOW.

Stanford's Geog.l Estab.t

The clusters which blossom in the spring, popularly called "palms," are *staminate* or *pistillate catkins.* Compare the two drawings on Plate 21. On the left hand is the staminate; that on the right is the pistillate tree. The catkins are stalks densely covered with green bracts. There is no trace of a calyx in the Willow (though the Poplar, which agrees in other respects with the Willow, has a small cup-like calyx), or of a corolla, but two or more stamens only stand in the axil of each bract of the so-called staminate catkin, as seen in Fig. 1. It is similar with the pistillate catkins. They, too, are composed of a stalk covered with bracts, and in the axil of each bract is a pistil composed of two coherent carpels (see Figs. 2 and 3). When they ripen, the catkins fall off, and look like woolly caterpillars, for the little *capsules* burst, and liberate their hairy seeds (Fig. 4).

In front of each pistil, as well as in front of the stamens, is a little *stump-like* gland (Figs. 1 and 2) which secretes honey. This attracts bees, which carry the pollen from one tree to another. The wind also carries it in many cases, and so fertilizes the pistils.

In examining the Poplar, look first at the way in which the leaves are wrapped up in the bud. Cut one across, and try to copy the appearance of the cut edges, as explained in the case of the Violet.

Note the peculiar way in which the leaves of the Poplar, when they are fully formed, quiver in the wind. The Aspen Poplar shows this especially well. It is due to the fact that the leaf-stalk is flattened about half-way between its attachment to the twig and the blade.

The Poplar differs from the Willow in having a fringed bract, as well as a small cup-like calyx, which includes several stamens on the one hand, and a pistil on the other. The staminate and pistillate catkins are on separate trees, as in the case of the Willow.

As the Willow and Poplar are the *only two genera* which make this family, a general description will not be needful.

Many Willows afford useful timber, what are called the White Willow and the Bedford Willow are examples, while the bark is said to contain even more tannin than the Oak. The Weeping Willow is not British, having been introduced from the banks of the Euphrates, and only the pistillate tree is known in this country, hence it cannot set seed, but is easily propagated by cuttings. The species used for hampers and basket-making are usually called Osiers. The bark of several species can be used for a valuable medicine resembling quinine, as it produces a substance of a similar character called *salicine*. It has, however, been made artificially.

SUBCLASS II.—GYMNOSPERMS.

THE PINE FAMILY.

THE SCOTCH FIR, YEW, AND JUNIPER.

These three trees or shrubs differ from all other British plants in having no carpels, so that the ovules have to receive the pollen *at once*, instead of its falling first on to the stigma, then sending its little tube down the style until it reach the ovule within the ovary,

SCOTCH FIR.

Stanford's Geog.l Estn

as in *all* other flowering plants. Hence these plants belong to one of four families called *Gymnosperms*, which means *naked seeds*. We have only these three in Great Britain, but there are several others in foreign countries.

All other genera of the Class Dicotyledons have their seeds included within the ovary which has become the fruit, as in all the plants hitherto described. Hence, as the Greek word *angion* means a *vessel*, the word *Angiosperms* has been invented as the name of the Subclass I. which contains them, and which stands at the top of page 6.

In the Scotch Fir (which produces its stamens and pistils in May and June) several stamens (of which Fig. 1 represents one by itself) form little oval, catkin-like bodies, the flap-like ends of the stamens above the anther-cells overlapping one another like tiles on a roof, while these little catkins are themselves crowded in great numbers in the young branches, as shown in the left-hand drawing. They scatter an enormous quantity of pollen, which is sometimes blown by the wind in such profusion as to give the appearance of a cloud of sulphur!

The young cones (one of which is at the end of the shoot in the right-hand drawing) which carry the ovules, consist of round, pinkish scales, with two ovules on their inner or upper face, as shown in Fig. 2. The ovules are attached upside down, each having a rather large hole at the lower end, into which the pollen grain tumbles when blown towards it by the wind. Each scale which carries the ovules has a small round bract behind it, as shown in Fig. 3. When the ovules

have been fertilized, the scales close up, press tightly one upon another, and conceal the now enlarging ovules, as shown in the swelling cone in the right-hand drawing. They all grow together, the scales become woody (the *bracts* having disappeared), thickening at their tips, while the ovules become seeds carrying a long, wing-like appendage, which has grown from the upper end (see Fig. 4).

When the cone is ripe the scales separate again, and spread out so that the seeds can escape. Their long wings enable them to fly to a considerable distance, and as soon as they reach the ground the wing becomes detached, and the seeds grow into young plants. When the embryo grows up, a curious difference is observable between it and almost all other plants, in that there *appear* to be *several cotyledons* instead of two only as in other Gymnosperms and Dicotyledons, as described in the case of the Pea (p. 34).

This appearance is due to the two cotyledons being each divided into several segments.

In the Yew-tree the stamens are never on the same tree with the ovules, as they are in the Fir-tree. They are curiously like little umbrellas, only with six bags below the hood, which contain the pollen. The ovules are quite destitute of any special scale or bract like that of the Scotch Fir, but stand in the middle of a little cone-like structure. When they have been fertilized, a green little cup grows up around the seed, and which turns to a bright scarlet when it is ripe. It tastes very sweet, and is harmless; but the green seeds within this scarlet cup are *poisonous* and should never be swallowed, as children have been poisoned by them.

The leaves of the Yew-tree are also poisonous, for cattle have often died from eating them.

The Juniper is a shrub or small tree common on moors and downs. It has sharp-pointed leaves, and bears a fruit like a purple berry. It is made up of three fleshy scales with three seeds, one to each scale. The scales were open at first at the top, though slightly coherent below; so that the pollen could fall in between them and down upon the three ovules below. The scales, however, close up as soon as the ovules have been fertilized, and then form the so-called Juniper berry. They are very wholesome, and a good tonic, and are used for flavouring gin.

GENERAL DESCRIPTION OF GYMNOSPERMS.

Trees or **Shrubs.** Leaves *evergreen*, often needle-like.

Flowers with stamens and naked ovules on the same or on different plants.

Fruit of cones or berries.

There are a great number of different kinds of Pines or Fir-trees, which supply us with very useful wood, called Deal. The Yew-tree was famous for the bows made of it in former days. It is one of the longest-lived trees; some trees in England are known to be several hundreds of years old.

Fir-trees are also useful for the great quantity of *Rosin* and *Turpentine* they yield. You may often see it oozing out from a wound in the bark. The raw turpentine is distilled, when what is called *Spirits of Turpentine* is obtained, and *Rosin* is left behind. The spirits of turpentine is used in making paint, and the rosin for sealing-wax and varnishes.

CLASS II.—MONOCOTYLEDONS.

THESE words mean that we have now entered the second class of the *two* great groups of families into which *all* flowering plants are divided. If you turn to page 6 you will see it headed, CLASS I., DICOTYLEDONS, and the meaning of the word was explained on page 34, where you will find that this name depends upon the structure of the embryo in the seed, the two halves, as of "split-peas," being called cotyledons. The term MONOCOTYLEDONS means that all the plants hereafter to be described have only *one* cotyledon in their embryos, as will be more fully explained in describing a grain of wheat on page 98.

There is another character of importance by which you may distinguish almost all Monocotyledons from Dicotyledons, and that is by the so-called *veins* of the leaves, or what makes the *skeleton* of the leaf. In Dicotyledons it is always more or less like an irregular network, but in Monocotyledons the veins run parallel, or straight (or occasionally slightly widening out in the middle, as in the Lily of the Valley) from one end to the other. For example, if you hold up a blade of grass to the light, you will see the nearly transparent veins very plainly. It is the same with the Flag, Daffodil, Bluebell, &c., hereafter to be described. One of the very few exceptions is the *Arum*, as you may see on turning to Plate 28.

A third distinction between these two classes is to be

YELLOW IRIS.

Stanford's Geog.l Estab.t

found in the structure of the *wood.* When describing the Willow, mention was made of the structure of the stem, which shows a number of *rings* when cut across, each ring-like mark indicating one year's growth (p. 70). But in no Monocotyledon is this seen. We do not possess any monocotyledonous trees in England, and only one shrub—the Butcher's Broom, as it is called; but the cut end of a stick of Asparagus will answer the purpose. You will see no *rings* at all, but a quantity of *dots;* and if you cut the Asparagus down you will find the dots to be the cut ends of *cords.* Now fancy this stick of Asparagus to be hard instead of soft, these cords would be *fine rods of wood,* as it were, running through a sort of hardened pith. If you have an opportunity of examining a piece of the wood of a Palm-tree—and young shoots of Palm-trees are often made into walking-sticks, umbrella and parasol handles—you will see it is just the same. They are mostly black or dark-coloured, having fine streaks on the surface, which are the woody cords, while the handle usually shows their cut ends as dots.

THE IRIS FAMILY.

THE YELLOW FLAG OR IRIS.

The Yellow Flag * is one of the handsomest of our water plants, blossoming in June and July. Its long, sword-like leaves grow from a thick, creeping stem, called a *Rhizome.* The yellow flowers issue from

* The large purple Garden Flag will do quite as well for examination by the pupils.

ED ORCHIS.

Stanford's Geog.l Estab.t

petal-like arms above, as shown in Fig. 2. These arms bend outwards and press down upon the three outer leaves of the perianth, as seen in the drawing. To find the stigmas you must look just above the anthers on the under side of the broad, curved styles, and you will discover a little ledge on each, so that the style looks something like the top of a spoon with the bowl downwards, and carrying a little fringed flap beyond it at the ends. That little ledge is the stigma. As its position is *above* the stamens, the pollen is hardly likely to fall upon it readily. If, however, a humble-bee alights on any one of the three reflexed outer leaves of the perianth, and forces its way in between the latter and the style, which you have seen is pressed down upon it, the stamen will dust the bee on her back, and when she scrambles into another flower, the spoon-like tip will scrape the pollen off her back on to the ledge-like stigma; and so the flower will be fertilized.

Another plant of the Iris Family is the Crocus. It differs from the Flag in having a *solid bulb*, called a *Corm*, somewhat like that mentioned on page 6, which is peculiar to the Bulbous Ranunculus.

The six parts of the perianth are all of the same shape and size. It has only three stamens like the Iris, and the anthers are also *extrorse*. The stigmas are orange-coloured, and, instead of spreading out as in the Iris, they are erect and form a sort of brush in the middle of the flower. The three spear-shaped anthers are also erect, and stand just below the three stigmas.

If you watch bees visiting the blossoms of the crocus on a warm spring day, you will easily see how beauti-

fully the column-like arrangement of stamens and pistil is suited to them. The narrow, funnel-like tube of the perianth prevents the bee from crawling down upon it to the honey, so she alights on the stigmas, and then grasping the anthers and style together with her legs, crawls head downwards. The anthers being extrorse, discharge the pollen upon the under side of the bee, and when she flies away to another flower and alights on the stigmas, the latter brush off the pollen, and so the ovules become fertilized.

GENERAL DESCRIPTION OF THE IRIS FAMILY.

Herbs with Bulbs, Corms, or Rhizomes.

Leaves narrow and long.

Flowers with a mostly regular, superior perianth of two whorls; stamens, three only, with extrorse anthers; styles petal-like.

Fruit, an inferior capsule, with many seeds.

There are several kinds of Flags grown in gardens, which come from Siberia and other countries. A large white one has a rhizome which smells like violets. It is dried and ground to powder, and gives the scent to what is known as Violet-powder. The scraped rhizome, resembling ginger, is sold as "Orrice-root," a word really the same as Iris-root.

Many species of Crocus are also grown as garden plants. There is one kind from which the orange stigmas are cut out, dried, and sold under the name of Saffron. It is used for obtaining an orange dye which it yields. Great quantities used to be grown at Saffron Walden, in Essex, and gave the name to that place.


p m
st
p.
p m.
g
1
2
SP

THE ORCHIS FAMILY.

THE SPOTTED ORCHIS.

We have now a very curious flower to dissect. You will find it in perfection in May and June. We must dig it up by the roots. You will find it has two fleshy roots resembling the palm of the hand with a few fingers. One of these two roots is formed every year, and supplies food for the next year's flowering-stem. It grows from the side of the previous one, just like the club-shaped roots of the Lesser Celandine, mentioned on page 1.

Pick off a flower from the axil of the coloured bract; it seems to have a twisted stalk, as shown in Fig. 1; but this is really the ovary, and the flower is consequently upside down. The ovary is inferior, i.e. sunk into a receptacular tube, though in this case it must be very thin, not like the apple (see p. 39). There are six leaves to the perianth,—three outer, which you must first remove; then two smaller leaves, arching over the middle; and one large leaf called the lip, which has three segments and a spur. There is but *one* stamen, of which only the rather large two-celled anther is seen, standing on the top of the ovary. A little white *pouch* hangs over the entrance to the spur. There is no style, but the stigma consists of a shiny, sticky surface at the back of the entrance to the spur, just under the pouch. Fig. 1 shows you part of the flower. The spur is cut open to show the stigma (*st*); the pouch (*p*) overhanging it, and the anther is cut away to show how the *pollen-masses* (*pm*), as they are called,

lie within it. The pollen is very curious; for, instead of being powdery, the *grains* are all joined by elastic threads into a club-like mass; the threads uniting together form a "handle" to the club (Fig. 2), ending in a little *circular disk*; the small ends are hidden in the little pouch, while the thick ends (composed of the united pollen-grains) are within the anther-cells. The pouch is full of gum (Fig. 2 *g*). Now take a sharp-pointed pencil, pass it down the opening of the spur, and in so doing push the pencil lightly against the pouch, as shown by the arrow in Fig. 1. Hold it there a few seconds. Now withdraw it, and you will pull out one or both of the pollen-masses. The gum dries, and fixes them erect. Fig. 2 shows a pollen-mass supported on its little circular disk, which stands on a drop of gum below. Now watch the pollen-masses on your pencil. They will gradually bend downwards towards the point of the pencil, until they lie along it. You must fancy a bee to have done this, and to have extracted the pollen-masses on her head. Then, when she flies to another flower, or if you pass your pencil down the spur of another flower, you will *now* find the pollen will hit against the shiny, sticky *stigmatic surface*, just below the pouch, and which will tear off some of the grains as you attempt to withdraw the pencil.

Orchids, as botanists call generally the plants of this family, are of all flowers the most curious. Many strangely resemble the forms and colours of insects; hence botanists have named them the Fly, the Spider, the Butterfly, and the Bee Orchis. Then there is the Man and the Monkey Orchis as well.

You should try and get a specimen of the Bee Orchis, which is very common on the chalk hills of Sussex, and on the Cotswolds and elsewhere, and compare it with the Spotted Orchis. It has one peculiarity not common in other members of this family; namely, that while every other kind can set no seed if it be not visited by insects (for you have seen how the pollen-masses are firmly fixed in the anther-cells, and cannot possibly escape unless they be removed), the Bee Orchis *can* and *does* set seed of itself abundantly. The means by which it does this is as follows:—The anther stands rather high up above the flower, on what is called a *column*, and the stigma forms the back of an open chamber just below it, and above the humble-bee-like lip of the perianth. Now the stalk or "handle"-like end of the pollen-mass is *bent*, so that if the plant is shaken, as by the wind, the heavy club-end tumbles out of the anther-cell above, but the other end remaining fixed, the pollen-mass now jerked down swings backwards and forwards in front of the *stigmatic chamber* below, and so the pollen cannot fail to strike the stigmatic surface within.

GENERAL DESCRIPTION OF THE ORCHIS FAMILY.

Herbs, often with tuberous roots.

Flowers distinguished by their very curious shapes; perianth superior and irregular; stamen, one only (two in the Lady's Slipper), the anther being fixed at the back of, or just above, the stigma; pollen-grains coherent into masses.

Fruit, an inferior one-celled capsule with innumerable minute seeds.

A great number of foreign species are now cultivated

for their quaint appearance, delicious perfume, or curious and beautiful flowers. In a very large flowering kind from the West Indies * the lip forms a large bowl, into which it secretes water, and bees, when they fertilize it, are compelled to take a bath before they can escape; and when they do get away the first bee carries off the pollen; but to fix it upon the stigma of another blossom it must have a second bath before it is allowed to pass through the narrow passage where the stigmatic surface is to be found!

Very few Orchids are of any special use. There is only one of importance, called Vanilla, which grows in the East Indies, and which bears juicy, strong-scented pods, which supply us with the flavour often imparted to chocolate. The tubers of some species of Europe and India are used for making a drink called Salep, formerly drunk in England, but Coffee has superseded its use.

THE DAFFODIL FAMILY.

THE COMMON DAFFODIL.

This family only differs from the next, or Lily Family (of which the Bluebell and Lily of the Valley are selected as types) by having the ovary *inferior*, whereas all kinds of Lilies have it *superior*. Like Lilies, too, many of this family have bulbs underground.

Dig up a plant by the roots, and let us examine the bulb. It is really an underground bud, consisting of a

* *Coryanthes macrantha.*

DAFFODIL.

Stanford's Geog.l.

short, thick stem covered with *leaf-scales*, containing nourishment for the flower, and are the bases of leaves which mostly have no green tops. Now, observe one of the innermost scales, which bears a leafy top; hold this green blade up to the light, and you will see the *veins* are straight, like transparent lines running side by side from one end to the other, as already mentioned on page 76 as being characteristic of Monocotyledons.

Before you examine a flower, be sure it is *not* a "double" one but "single," as all wild specimens are. As they blossom in March and April, they are called Lent Lilies.

The flower is one very easy to understand. The inferior ovary is obvious, upon which the bright yellow perianth stands. It has three outer leaves and three inner; but they all six spread away much on the same level. In the middle is a long tube with a toothed edge. This is called the *corona* or *crown*, and is an *outgrowth* from the perianth.* It is unusually large in the Daffodil, but forms a mere *rim* in the Jonquils and other kinds of Garden Narcissus. Six stamens are adherent to the perianth within the crown, as shown in Fig. 1, which represents part of the flower, the six leaves of the perianth being cut away. Lastly, the style with three small stigmas completes the flower.

As grown in gardens, the Daffodil is often double, and is then useless for examination, for it has no stamens nor pistil; but instead of these the perianth and corona are repeated over and over again.

* Fig. 1 shows the inferior ovary cut open, with the corona bearing the stamens within. It is reduced in size.

BLUEBELL

Stanford's Geog.l Estab.t

material of which the Mexicans make paper. It is popularly described as flowering once in a century, and then dying. This is true, but it is quite uncertain *when* it may blossom, for it may be at its tenth, twentieth, sixtieth, or any other year. When, however, it does produce its tall flowering-stem—sometimes forty feet in height, with thousands of blossom—it *must* die, for it has no other bud except the end one, and when this has ended in flowering, the plant perishes.

THE LILY FAMILY.

THE BLUEBELL.

Like the Daffodil, the Bluebell, which blossoms in May, springs from an underground bulb, and has long, narrow leaves, with the veins running straight from one end to the other, without any irregular network.

The stem in the middle of the bulb forms the flower-stalk. Note the two little pointed and purple bracts at the base of each flower.

There is no distinction between a calyx and a corolla, so we must call the outer whorls a *Perianth*, as in the case of the Orchis and Daffodil. There are three outer leaves and three inner, the six taken together making up the perianth. Each of the perianth-leaves has a stamen adherent to it. There is a free *superior* pistil (Fig. 1). This is the most important feature which distinguishes the whole Lily Family from the Daffodil Family. Cut the ovary across, and you will easily see that it is made of three carpels, as there are three little chambers,

with six rows of ovules in all, two rows in each chamber; just as if you took three pea-pods and put their edges together, and then made them unite by their sides.

A great number of Lilies, such as the Turk's Cap, the common White Lily, several kinds of Tulips, the Fritillary, and many other genera of this Lily Family, are cultivated for their beauty; while Onions, Leeks, Shalots, and some other species—all having the same peculiar flavour—belong to one and the same genus, called in Latin *Allium*.

The Bitter Aloes used in medicine is the juice from the thick leaves of plants from Barbadoes, the Isle of Socotra, and Africa. These plants, like our garden Yucca or "Adam's Needle," resemble the so-called American Aloe; but that plant, as already described, belongs to the Daffodil Family, because its ovary is inferior, whereas that of the true Aloe is superior.

THE LILY FAMILY—*Continued.*

THE LILY OF THE VALLEY.

The Lily of the Valley, in full bloom in May, has no bulb, but a long, creeping, underground stem.

Observe how the veins of the leaf run from the bottom to the top, slightly *curving* in the middle, making the leaf broader at that part; hence the veining is said to be *curvinerved*. It is only a slight change from the straight or parallel-nerved kind common to Monocotyledons.

This plant is selected as a second type of the Lily

LILY OF THE VALLEY.

Stanford's Geog.l L

Family, as having its perianth leaves all united, as in the Daffodil; but it has no corona. The stamens are adherent to the bell-like tube, as shown in Fig. 1. The pistil (Fig. 2), as will be seen by cutting the ovary across, is made up of three carpels. It forms a scarlet superior berry when ripe (Fig. 3), and so differs from the fruit of the Bluebell, which is a dry capsule.

The Asparagus is like the Lily of the Valley in bearing red berries in the autumn; but instead of leaves it has nothing but clusters of needle-like green branches, which do duty for leaves, and give the feathery appearance seen in summer.

The Butcher's Broom, mentioned on page 77, is a third plant of this family which has berries, and also no leaves; the flat, sharp-pointed, leaf-like structures being really branches, which carry the little flowers and red berries in the middle. This plant has already been mentioned as the only British shrub belonging to the Class Monocotyledons, all other trees and shrubs being Dicotyledons.

A general description of the Lily Family will be exactly the same as that for the Daffodil Family, excepting in one particular: that whereas in all of the Lily Family the ovary is free above the perianth—that is, *superior*—in the Daffodil Family it is always *inferior* and below the perianth.

THE ARUM FAMILY.

THE SPOTTED ARUM.

The Spotted Arum, or Lords and Ladies as the plants are often called in the country, springs from a thick, tuberous rhizome, which contains a good deal of starch, like the Potato. It was formerly cultivated in the Isle of Portland for the sake of the starch, which was then called Portland Sago. The leaves are arrow-shaped; and what is particularly to be observed is that the veining is netted, resembling that of Dicotyledons. There are only three other British plants which have so decidedly an irregularly netted leaf, and are at the same time Monocotyledons. One is called the Black Bryony, which may be easily known by its very glossy, heart-shaped, but pointed leaves. It climbs through and over hedges, and bears scarlet berries. The second is the Herb Paris, found in woods. It has a whorl of four or more leaves and a single short stem, which bears a green flower at the top. Its fruit is a blackish berry. The third is the Arrowhead, a water-plant, with pinkish-white flowers, and with leaves of the shape of an arrow, much like those of the Arum. These three plants belong to separate families, not otherwise alluded to in this book.

Let us examine carefully the flowers of the Arum. The large hooded leaf is really a bract, and called a *Spathe*. Observe how it is pinched in like a waist at one point. Open it out, or cut the spathe entirely away, and you will find a curious stem in the middle, covered with different kinds of organs, as shown in

SPOTTED ARUM.

Stanfords Geog.ˡ

Fig. 5, which represents the *Spadix*, as the whole stalk is called, of the natural size.

Let us begin at the bottom, and work upwards. You first see a number of green pistils (*p*), with round, ball-like ovaries and *sessile* stigmas—i. e. there are no styles to carry the stigmas, so they are *seated* on the ovary itself. Just above these pistils (each of which stands for a separate flower) there are some smaller pistils with long styles (*ab*, *p*, and Fig. 2). Curiously, however, these never set any seed, while the larger ones, without styles, do.

Next follows a ring of purple or crimson stamens (*st*). Each stamen, you will easily see with the aid of your lens, has four anther-cells, each of which opens by a pore at the top, as shown in Fig. 1. Then come some more *abortive* pistils, forming a sort of fringe just where the spathe is contracted; and, finally, the stem ends with the pink or purple club-like extremity, called the *Appendix*, the whole, as stated, constituting the spadix.

As the stamens are placed above, and not below the pistils, the spadix cannot be a single flower but is an *inflorescence* of many flowers; so that each pistil and each stamen must be looked upon as a flower in itself, but wanting all the other parts which usually go to make up a flower—that is to say, each pistil requires a perianth and stamens, and each stamen must be looked upon as wanting a perianth and pistil.

That this is a correct idea is seen from another genus —the only other—which, together with the Arum, represents the Arum Family in Great Britain. It is called the Sweet-flag or Reed-mace, a plant with

long, narrow leaves, and with a spadix exposed, not being wrapped up in a sheathing spathe. The flowers, however, have all got a perianth, while this includes both stamens and pistil together.

The process of fertilization of the Arum is somewhat interesting. The stigmas mature *before* the anthers shed their pollen, and when this does take place the stigmas have withered, so that it cannot fertilize itself. Small insects, however, enter the spathe, and crawling downwards get imprisoned below by the fringe of hairs, which, while it allows them to enter, prevents them from returning. After a time, however, when the insects may have deposited any pollen they brought with them upon the stigmas, then the anthers open their pores; and, furnishing the captives with a new supply of pollen, they are now allowed to escape, as the fringe has by this time shrivelled, and so affords no hindrance to their exit. Sir John Lubbock * tells us that sometimes more than a hundred flies will be found in a single Arum!

During the summer the spathe gradually withers and falls off; so does the top of the spadix, leaving only the lower part, which bears the large pistils. These swell and grow scarlet, so that in the autumn you may often find a green stalk with a dense cluster of scarlet berries on the top. This is the fruit of the Arum.

GENERAL DESCRIPTION OF THE ARUM FAMILY.

Herbs with an acrid juice. Leaves often net-veined.

Flowers on a spadix, with a spathe; perianth

* 'British Wild Flowers in relation to Insects,' p. 29.

COTTON-SEDGE.

Stanford's Geog.l Estab.t

present or none; stamens and pistils together or separated.

Fruit usually a superior berry.

Several members of this family are to be seen in hot-houses and gardens, as they principally grow in tropical countries. One, however, the so-called Trumpet Lily, which has a long, rather thick white spathe surrounding a yellow spadix, is a common drawing-room plant.

There is one plant called *Monstera deliciosa*, of which the perfumed spadices are sold in the Mexican markets, and which are said to be equal to the Pineapple in flavour. On the other hand, many are very poisonous. Slave-owners used to punish slaves by making them bite the spadix of one called the Dumb-cane, from the terrible effects it had on the tongue, rendering the biter speechless for some days.

THE SEDGE FAMILY.

THE COTTON-SEDGE.

There are two families, called the Sedge and the Grass Families, which differ from the rest of Monocotyledons, not only in having no perianth, but, instead of it, the stamens and pistil are protected by what are called *Glumes*, and which form the dry scales known as *Chaff*, when, for example, wheat is thrashed. Hence these two families are sometimes called *Glumiferous*, or glume bearers. The leaves of the plants of both orders are much alike—long, narrow blades, having

the veins running straight from end to end; though the lower part which sheathes the stem is *split* down the opposite side to the blade in Grasses, but forms a complete sheathing tube in Sedges.

The *inflorescence* consists of *spikelets* grouped in various ways; sometimes tufted, as in the Cotton-sedge; or in long catkins, as in the true Sedges. In Wheat, the little spikelets are arranged in two ranks upon a stem, and so make the *Ear*. In the Oat they are grouped into a loose bunch, called a *Panicle*. A *spikelet* only means *little spike*, and a spike is a common stalk which carries flowers seated upon it, but without separate stalks of their own. Thus, the common Plantain is a dense spike.

In the Cotton-sedge, which will be found in May and June, each flower of the spikelet consists of a single glume, then a quantity of hairs, at first rather short, and within them three stamens and a pistil with one style bearing three stigmas, as shown in Fig. 1. When the pistil ripens into a fruit (Fig. 2) the hairs grow to a considerable length, and then form the long, silky tufts which the plant bears, and which gives it its name. It is often called *Cotton-grass*, but the word *Grass* is wrong, as it does not belong to the Grass Family.

Attempts have been made to weave this hair, but without success. It is useful, however, for stuffing cushions.

The genus of this family which contains the most species is the true Sedge, or *Carex* as botanists call it. In this plant the stamens and pistils are in separate catkins; but, with rare exception, both kinds of cat-

kins are on the same plant. The staminate flowers consist of a glume with two or three stamens, the pistillate, of a glume and a pistil of two or three carpels, as shown by the number of styles, and which is invested by a bottle-shaped structure, supposed to be made of two glumes united by their edges, and so including the pistil between them.

GENERAL DESCRIPTION OF THE SEDGE FAMILY.

Herbs grass-like.

Leaves narrow, with a closed, tubular sheath.

Flowers in catkins, &c., perfect, or with stamens and pistil separated in the axils of glumes; often with bristles or hairs surrounding the stamens and pistil.

Fruit one-celled, nut-like, with a single seed.

There are several genera in the Sedge Family, but few are of any use. A very tall, reed-like plant, growing in lakes and rivers, is called *Bull-rush* by some people, though this name is more often given to a very different plant, with a tall stem and dense *brown* end, with the shape of a poker, and which does not belong to the Sedge Family at all. The Bull-rush of the Sedge Family is used for making *rush*-bottomed chairs; yet they are not true Rushes which belong to yet another family. The *Papyrus*, which grows in Egypt and elsewhere, used to supply a substance out of which a rough kind of paper was made, the word *paper* being taken from the name of the plant.

THE GRASS FAMILY.

THE COMMON WHEAT.

Wheat, which is in flower in July, and all other kinds of *Corn* crops, are really Grasses; the Buck-wheat, as we have seen (p. 64), being not really a corn at all.

The sheath of a grass leaf is split on the opposite side to the blade, and thus differs from any plant of the Sedge Family. It also carries a little appendage called the *Ligule* (*l* in the drawing).

Grasses agree with the Sedges in having no true perianth; but their flowers are protected by glumes or chaff-scales. The ear of wheat is made up of spikelets placed in notches on the stalk, on opposite sides of it. Pick off one of these spikelets, and carefully remove its different parts. There are two chaff-scales or *outer glumes* at the bottom (Figs. 1 and 2). Remove them, and then you will see that the spikelet is composed of *four or five distinct little flowers* or *florets* placed on alternate sides of the little stalk which carries them. Pick off the lowest floret. There is a glume much like the first you removed. This is called the *Flowering glume* (Fig. 3). It overlaps another called the *Pale* (Fig. 4), which, however, differs from it in being of a thinner texture. It has two little points terminating two ridges or *keels*, while the flowering glume had only one central point. The edges of the pale are like flaps, and so protect the stamens and pistil within them. The next parts are rather difficult to see; but if you hold the floret up, after removing the

WHEAT.

Stanford's Geog.L Est.

flowering glume, you will notice two very small bodies at the bottom, and which face you, just between the edges of the pale. These are called *Lodicules* (Fig. 5). You may be able to pick them out with a pin. Then follow three stamens, with long, thread-like filaments, and bearing long anthers, which are said to be *versatile*, because they can swing about very easily (Fig. 6); and, last of all, in the centre is the pistil with its two feathery stigmas (Fig. 7).

Such is the structure of a single floret, and it is the same for the three or four other florets of *each* spikelet, excepting the *terminal* or end floret. This one consists of only a small flowering glume and pale, without anything else, so that it cannot produce a grain of Wheat at all. If, however, only *three* florets of each spikelet produce grains, and supposing there to be twenty spikelets in each ear, such would produce at least sixty grains; and as one grain sown often carries several ears, we see that a single grain of Wheat may produce some hundreds in one season.

We will now examine a grain of Wheat, or, what would be better still, a well-soaked grain of Indian Corn. You will notice in a grain of Wheat that it is grooved down one side, but rounded on the other, as shown in Figs. 8 and 9. The round side has a wrinkled spot at one end. If you cut the grain in two down the groove, you will find that the little embryo has been cut in half, and that it lay exactly under the wrinkled spot, as shown in the section Fig. 10, while all the rest of the grain is composed of a white substance, which when ground in the mill makes *flour*. This white substance is called *Vegetable Albumen*, because just as the white

of an egg nourishes the young chick in the egg, and is called by chemists *Animal Albumen*, so does the white flour nourish the little embryo when it begins to grow, until it has roots and green leaves of its own. It so happens, however, that seeds of plants vary very much in this respect. Very many have got albumen round their embryos; others have no albumen, and then the embryos are usually very much larger, and fill up the whole of the space within the seed skin. When a seed has no albumen it is called *exalbuminous*; when the embryo is imbedded in albumen the seed is said to be *albuminous*. We examined a Pea, and we found the embryo filled up the whole of the seed skin. It is just the same with Beans, Almonds, Nuts, Acorns, Walnuts, Chestnuts, and many others. As these have no albumen, if they are eatable, it is the large embryo that you eat. On the other hand, all kinds of grains, or *cereals* as they are called, are albuminous, like the Wheat. Examples of other plants whose seeds have albumen are the Buttercup, the Violet, the Ragged Robin, Primrose, the Scotch Fir, and all the monocotyledons described in this book.

The next point to notice is the structure of the embryo itself. If you can get some Indian Corn from any corn-seller, soak the grains for a few days in boiling water, as they are very hard. You can then pick out the embryo, which you will find lying in a little basin-like depression in the hard, yellowish albumen. The embryo is flat on one—the outer side—and rounded on the other. Examine the flat side carefully, and you will detect a little slit in the middle. Open it out, and a minute bud lies hidden within the slit. This

bud is the plumule. This outside part, rounded behind and *folding over* with its two flat edges in front, is the *single cotyledon*, which thus protects the little plumule within; the lower part being the radical end. This cotyledon takes the form of a *little shield*, so some call it a *scutellum*. As there is only *one cotyledon*, this is of course a *Monocotyledon*.

There is a very great similarity in the structure of the florets and fruits or grains of all Grasses. A few points of difference may be noticed. In some kinds of Wheat the little point you see on the top of the flowering glume (Fig. 3, and see upper end of the drawing) grows out to three or four inches in length. It then forms what is called an *awn*, and Wheat with awns is said to be *bearded*. Barley and Oats always have such awns. In one kind of Grass, called Feather-Grass, the soft, hairy awn is nearly a foot in length, and forms a pretty ornament when made into bundles.

As in the Wheat, most Grasses have the stamens and pistil in the same flower, but Indian Corn has them separated; the staminate spikelets are grouped in a large feathery bunch at the top of the plant, while the pistillate spikelets are compacted together into a great solid mass or *cob* in the axils of the lower leaves.

GENERAL DESCRIPTION OF THE GRASS FAMILY.

Herbs with hollow stems, called *culms*, with solid joints.

Leaves with a split sheath, and a long, narrow blade with a ligule.

Florets in spikelets, consisting of flowering glume and pale, enclosing lodicules, stamens, and a pistil bearing two feathery stigmas.

Fruit, an albuminous grain, with small embryo on the surface of the albumen.

I need hardly describe the uses of the cultivated Grasses, for wheat and rye bread, oatcake, and barley-meal and other foods are too well known. *Brown* bread is made from the outer part of the grain, sifted from the white flour, which, as we have seen, is the albumen. Millers sift the flour into three kinds—*Firsts*, or the central part of the grain; *Seconds*, or the next to it, or intermediate part of the grain; and *Thirds*, or the outermost part. Now the *Seconds* is really the most nutritious, the *Firsts* being mainly used for making biscuits, the *Thirds* or *Bran* for brown bread; which, though it contains really more nutritious matter than the Seconds, is yet not so digestible, because the skin of the grain contains *flinty* matter, which is *stony* and unwholesome. The bright polished look of a straw is due to the flinty substance taken up by the roots, dissolved in water, and left on the surface of the stems.

The Sugar-cane is a Grass, and differs from others in having its stem *solid* and full of sweet juice, from which sugar is got by crushing the stems and boiling the juice.

The Bamboo, which grows to sixty or seventy feet or more in tropical countries, is simply a gigantic woody straw!

THE PRINCIPLES OF VARIATION.

As we have now examined and discussed some thirty different plants, it will be desirable to group together the different ways or *principles* by which they vary from some supposed type or example selected to start from.

NUMBER.—This is the first principle to be considered. In many flowers the parts of the whorls are in threes, fours, or fives, or else very many. Other numbers occur, but are not quite so common.

COHESION.—This applies to any whorl when its parts are united together, as are the sepals as well as the petals of a Primrose; the stamens of the Broom by their filaments; the stamens of the Dandelion by their anthers; and, lastly, the carpels of very many flowers, as of the Wallflower, Lamium, Daffodil, and Bluebell.

ADHESION.—This refers to the union of any two or more whorls together, as when the petals and stamens are both united to the calyx, as in the Strawberry, or as the stamens to the corolla in the Primrose and Lamium, or to the perianth in the Lily of the Valley.

SUPERIOR.—When the pistil is quite free and stands *above* the calyx or perianth, so that its ovary can be cut away leaving the calyx or perianth behind, it is called *superior*, and the calyx or perianth is called *inferior*, as in Buttercup, Primrose, and Bluebell.

INFERIOR.—When the ovary of the pistil is sunk into and imbedded in the receptacle, i. e. invested by the re-

ceptacular tube, the ovary is called *inferior*, as in the flower of the Apple, Dandelion, Orchis, and Daffodil; the calyx or perianth in this case now becomes *superior*, and remains on the top of the fruit, which may thus be recognized as an inferior fruit, as are Gooseberries, Apples, Pears, Medlars, &c.

REGULAR.—When the parts of a whorl are of the same size and shape, the whorl is said to be *regular*, as are the petals of the Buttercup or Primrose, or the perianth of the Bluebell.

IRREGULAR.—When any part or parts of a whorl differ in size or shape from the rest, the whorl is called *irregular*, as the petals of the Pea, the stamens of the Violet, and the perianth of the Orchis.

If, now, we imagine a flower to be composed of, say, five free sepals, five free petals, five free stamens, and five free carpels, then *all* flowers can be referred to such a type or imaginary example, their differences as seen in any nosegay being entirely due to different combinations of the above *seven principles.*

THE PRINCIPLES OF CLASSIFICATION.

Plants are grouped or classified mainly by their flowers. We have seen how there are several *species* of Buttercup, that being the *Genus;* and that several *Genera* are grouped into a *Family;* and, lastly, all the families of flowering plants are grouped into two great *Classes*, called *Dicotyledons* and *Monocotyledons*, and of which each may be known by four peculiarities as follows:—

I. Dicotyledons.

1. The parts of the whorls of the flowers are generally in fours, fives, or many; as in the Wallflower, Geranium, and Buttercup respectively.

2. The wood of such as are trees or shrubs shows *rings* when cut across, and there is a distinct *pith, wood,* and *bark.*

3. The leaves are *net-veined,* as of all our trees.

4. The embryo of the seed has *two cotyledons* or seed-leaves, as in the Pea, or as seen in Mustard and Cress when they germinate.

Observation.—Three British plants, the Scotch Fir, the Juniper, and Yew, are separated in a *Subclass* called *Gymnosperms,* i. e. they have *naked seeds* with *no seed vessel.* All other Dicotyledonous plants form the subclass *Angiosperms,* i. e. *seeds in a seed vessel.*

II. Monocotyledons.

1. The parts of the whorls of the flowers are in threes or sixes, as in the Bluebell.

2. The wood of Palms, and of the only British shrub of this class, "The Butcher's Broom," is in separate cords running down the pith, as seen in Asparagus, and there is no true separable bark.

3. The leaves are straight-veined, as of all Grasses.

4. The embryo of the seed has only one cotyledon or seed-leaf, as seen in the Indian Corn, or when an Onion germinates.

LONDON: PRINTED BY EDWARD STANFORD, 55, CHARING CROSS, S.W.

Recently Published.

BOTANICAL TABLES

For the Use of Junior Students.

Table of Common Terms used in Describing Plants, comprising those usually required in the Cambridge Local Examinations for Juniors. Also, a Table of the Chief Natural Orders of British Plants, arranged according to Bentham and Oliver. By ARABELLA B. BUCKLEY.

Folded in Cloth Cover, 1*s.* 6*d.*

THE VEGETABLE KINGDOM.

By A. HENFREY.

(*Forming one of Stanford's Diagrams of Natural History.*)

Arranged according to the Natural System, each Order being illustrated by numerous Examples of Representative Species showing the Habits of the Plants, as well as Dissections of the Flowers and Fruits.

Mounted on Roller and Varnished, 6*s.*; folded in Cover, 4*s.*

Lessons from the Vegetable World.

(INSTRUCTIVE PICTURE BOOK, No. 2.)

By the Author of 'THE HEIR OF REDCLYFFE,' &c.

Fifth Edition, with Thirty-one Double-page Coloured Plates, Foolscap folio, 7*s.* 6*d.*

HORTICULTURE.

By F. W. BURBIDGE,

Author of 'Domestic Floriculture,' 'Cultivated Plants,' &c., &c.

Post 8vo, cloth, with Illustrations, 4*s.* 6*d.*

LONDON: EDWARD STANFORD, 55, CHARING CROSS, S.W.